A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

MARCH, 1937.

GENERAL PHYSICS.

ADSORPTION.

952. Interaction of Atoms and Molecules with Solid Surfaces. Part IX. C. Strachan. *Roy. Soc., Proc.* 158*A*. *pp*. 591–605, *Feb*. 3, 1937.—The interchange of energy between a crystal and an atom adsorbed on its surface is considered with special reference to exchanges in which a number of quanta are derived from, or communicated to, the heat motion of the solid. It appears that, within the limits of application of first-order perturbation theory, any change in which more than one quantum is emitted or absorbed by the oscillator corresponding to any normal mode of vibration of the crystal is very improbable. Other exchanges are governed by a factor which makes the probability of any energy interchange almost entirely dependent on that of the transition involving the minimum number of quanta which can provide the necessary energy. This is of importance in determining the validity of previous results relating to the desorption of the isotopic molecules of H_2 from a metal surface. The theory is also applied to estimate the average time intervals between successive deactivations of atoms of H and D from a state of migration on the surface of a metal. [For Parts VI–VIII see Abstract 406 (1937).]
AUTHOR.

953. Activated Adsorption of Hydrogen upon Smooth Nickel. O. Leypunsky. *Acta Physicochimica*, 5. 6. *pp*. 807–812, 1936. *In German*.—A study has been made of the kinetics of the activated adsorption of H_2 on a smooth Ni surface at − 145° C and − 118° C, following the experimental procedure of a previous publication [see Abstract 4928 (1936)]. At − 145° C. only 15 % of the gas was slowly adsorbed, and thereby provided an opportunity for the kinetic investigation of the process. The kinetic equation derived from Langmuir's theory of activated adsorption, indicated a satisfactory agreement with the experimental curve. The heat of activation $E = 2050$ cal., and the steric factor $f = 2{\cdot}2 \times 10^{-4}$, were determined from the constants of the equation. A discrepancy was found between the number of accessible adsorption zones as determined from the constants of the velocity equation and the actual amount of gas absorbed. The latter is 2·4 times greater than the computed value.
H. H. Ho.

954. Orientation of Molecules in the Surface Layer of an Adsorbent and the Adsorption of Gases. Part I. P. V. Afanasiev, B. A. Talmud and D. L. Talmud. *Acta Physicochimica*, 5. 6. *pp*. 853–862, 1936. *In English*.—Methods of preparation of unconverted and converted palmitic acid adsorbents are worked out to make possible a study of adsorption of gases by adsorbents with various molecular orientations on the surface. Adsorption of dry NH_3 is measured. Adsorption of dry NH_3 by palmitic-acid Gibbs layers " frozen " in paraffin is also measured. It is shown that adsorption of dry NH_3 by converted adsorbents cannot be due to a chemical reaction between NH_3 and palmitic acid. The adsorption of enormous quantities of NH_3 is due to the presence of converted adsorption planes at the surface and somewhat deeper, formed by uncompensated carboxyl groups. The formation of layers with uncompensated carboxyl groups in the adsorbent is due to a radical change in the orientation of palmitic acid molecules in the surface layer, as compared with their orientation in a palmitic acid crystal. AUTHORS.

955. Sorption of Deuterium Oxide by Cellulose. T. King and C. Ouellet. *Canad. J. of Research,* 14. *Sect. B. pp.* 444–449, *Dec.,* 1936.—The sorption of D_2O by cellulose at 23·4° C. was investigated over the whole range of vapour pressures and found to show the same characteristics as that of water. The molar quantities sorbed at a given pressure are equal, and the kinetic curves exhibit the same features. After desorption of D_2O, a small but permanent increase in the weight of the cellulose was observed. This suggested an exchange reaction between D and H atoms. AUTHORS.

956. Influence of a Magnetic Field on Adsorption. S. S. Bhatnagar, P. L. Kapur and A. N. Kapur. *Phil. Mag.* 23. *pp.* 256–264, *Feb.,* 1937.—An investigation of the adsorption in certain systems in and outside a magnetic field is described. The systems and results are as follows: adsorption by charcoal of $KMnO_4$ and $K_2Cr_2O_7$, increased adsorption in the field; decreased adsorption of $FeCl_3$; slight increase in adsorption of $K_4Fe(CN)_6$, but $K_4Fe(CN)_6 \rightarrow K_3Fe(CN)_6$. The field had no effect on the adsorption of $KMnO_4$ and $K_4Fe(CN)_6$ by $BaSO_4$. Results agree with the chemical theory of adsorption, and a theoretical discussion of the mechanism and the effect of the field is given. N. M. B.

957. Heats of Wetting. B. W. Iliin, A. A. Leontiew and S. W. Bragin. *Phil. Mag.* 23. *pp.* 294–301, *Feb.,* 1937.—Heats of wetting, Q, were determined by means of a microcalorimeter round which was wound a resistance thermometer. Values of Q found for KCl, KBr and KI passed through sieves of 900 mesh per cm^2. and wetted by CCl_4 differed only by 18 % from those of the same salts passed through sieves of 3,600 mesh. The smallness of this difference is explained mainly by the presence of small fragments of crystals. $BaSO_4$ crystals of various uniform sizes were obtained by Weiman's method. The specific surfaces were obtained by microscopic examination. When wetted by H_2O, C_2H_5OH and CCl_4, Q was found to be directly proportional to S. A theoretical computation of the work of wetting confined, for reasons given, to a consideration of the electrostatic dipole effect gives calculated values of S of the same order as those experimentally determined. P. H. B.

See also Abstracts 1071, 1072, 1073, 1353.

ATOMIC AND MOLECULAR STRUCTURE.

958. The Spectroscope and the Atom. A. Fowler. *Inst. Mech. Eng., Proc.* 133. *pp.* 269–293, 1936. *Hawksley Lecture.*—A lecture on the subject, the principal aim of which is to indicate how the spectroscope has contributed to our knowledge of the systems of electrons surrounding the nuclei of atoms, on which chemical and other properties are dependent.

959. Superior Limit to Atomic Numbers. G. Fournier. *Comptes Rendus,* 203. *pp.* 1495–1496, *Dec.* 28, 1936.—Considerations based on geometry and theory of numbers lead to the conclusion that the possible arrangements of octahedral helions and tetrahedral neutrons [see Abstract 412 (1937)] indicate 136 and 360 as the maximum possible atomic number and atomic weight respectively. C. A. S.

960. Nuclear Physics. S. Flügge and A. Krebs. *Phys. Zeits.* 38. *pp.* 13–36, *Jan.*, 1937.—This communication is supplementary to a previous publication [see Abstract 3212 (1935)], and contains a critical survey of the subject up to-date. Section I considers mass defects under the sub-sections of neutron mass, mass determination from nuclear transformations, mass spectroscopic data, heavy nuclei, comparison with chemical atomic weights. Section II deals with neutrons under the sub-sections of methods, results with rapid neutrons, absorption and scattering of slow neutrons. Section III reviews β-disintegration, for which two appreciable advances have been made in the theoretical extension of the Fermi theory by Konopinski and Uhlenbeck. The theoretical foundations are discussed, followed by an investigation of the shape of the continuum and of the Sargent relationship. Section IV deals with elastic impacts under the sub-sections of scattering of neutrons to protons, scattering of protons to protons and scattering of neutrons to complex nuclei. Section V considers the yield of transformation processes, and finally Section VI briefly reviews excited states and γ-radiation. The paper gives abundant data and illustrations, and concludes with a Bibliography of 112 references. H. H. Ho.

961. Nucleus ${}^{8}_{4}$Be. R. de L. Kronig. *Physica*, 4. *pp.* 171–174, *Feb.*, 1937. *In English.*—The properties of the nucleus ${}^{8}_{4}$Be as deduced from its behaviour in nuclear reactions are briefly discussed. AUTHOR.

962. Photographic Methods for Detecting Protons. Stefanie Zila. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 7–8. *pp.* 503–514, 1936.—For the purpose of detecting protons photographically it is convenient to desensitise the plates which are used, to avoid complications arising from stray light. The author describes experiments with pinacryptol yellow which show that adequate desensitisation can be obtained towards stray light, together with an enhanced sensitivity as regards protons, if this dye is used. An increased sensitivity towards protons can also be obtained by wetting the plates. This applies, however, only to protons with ranges of less than 10 cm. The value of the pinacryptol yellow as regards fast protons is lost if the experimental chamber contains air at anything approaching normal pressure. Other dyes have been experimented with, but have not been found so successful. Experiments are described which show that this method is capable of detecting range-groups in proton emissions. J. E. R. C.

963. Capture of Orbital Electrons by Nuclei. C. Moller. *Phys. Rev.* 51. *pp.* 84–85, *Jan.* 15, 1937.—In Fermi's theory of β-decay two processes are available by which a nucleus of charge Z can change into one of charge Z–1 : either by loss of a positron or by capture of an electron, *i.e.*, absorption of an orbital electron. In this paper the author gives theoretical results showing that the second of these processes is the more probable by a large margin. This contingency is also shown to be consistent with experimental results. G. O. B.

964. Artificial Disintegration of Boron and Lithium. B. Arakatsu, K. Kimura and Y. Uemura. *Taihoku Imp. Univ., Faculty of Sci. and Agric., Mem.* 18. *pp.* 75–94, *July*, 1936. *In English.*—An experimental study is made of the artificial disintegration of Li and B caused by bombardment of these elements with protons having energies between 100 kV and 220 kV. The disintegration particles are observed by means of a valve counter. A study is made of the variation with bombardment energy of the relative yields of particles produced by the two reactions : ${}_{3}\mathrm{Li}^{6} + {}_{1}\mathrm{H}^{2} \rightarrow 2\,{}_{2}\mathrm{He}^{4}$ and ${}_{3}\mathrm{Li}^{6} + {}_{1}\mathrm{H}^{2} \rightarrow {}_{3}\mathrm{Li}^{7} + {}_{1}\mathrm{H}^{1}$. With bombardment voltages of 120 kV the α-particles are about 20–30 times as numerous as the protons; at 200 kV the ratio decreases to about 5 : 1. By observation of the oscillograph records obtained from the valve counter it was possible when making these measurements to distinguish the α-particles from the protons produced by the reaction : ${}_1H^2 + {}_1H^2 \rightarrow {}_1H^3 + {}_1H^1$, which have a similar range. In the case of B the relative yields of the following two reactions are studied : ${}_5B^{11} + {}_1H^1 \rightarrow 3\ {}_2He^4$ and ${}_5B^{11} + {}_1H^1 \leftarrow {}_4Be^8 + {}_2He^4$. No significant variation in the relative yields is observed as the bombardment voltage is varied between 100 kV and 200 kV. Various speculations as to the heights of the potential barriers in B are given. J. E. R. C.

965. Disintegration of Beryllium by Protons. J. S. Allen. *Phys. Rev.* 51. *pp.* 182–186, *Feb.* 1, 1937.—The disintegration of Be by protons of energies from 45 to 125 kV is studied. The yield curve for a thick target is determined and the ratio of the number of α-particles and deuterons ejected from the target is determined for various voltages. The ratio is very close to unity. The ranges of both groups of particles are found to be 7·1 mm. From the energy relations the mass of Be^8 was found to be 8·0074. The experimental value of the effective area for collision is found to be of the same magnitude as that predicted by Gamow's theory of the penetration of a potential barrier by protons having zero angular momentum. AUTHOR.

966. Artificial Radioactivity of Thorium. Elisabeth Rona and Elisabeth Neuninger. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 7–8. *pp.* 479–482, 1936.—By bombarding a radiochemically pure sample of Th with neutrons from Be an artificially radioactive element with a half value period of 42 hr. has been produced. It is identified as an isotope of Ac. J. E. R. C.

967. Radioactivity from Artificially Produced Radioactive Substances. Part III. β-Ray Spectrum of P^{32}. H. C. Paxton. *Phys. Rev.* 51. *pp.* 170–177, *Feb.* 1, 1937.—The β-ray magnetic spectrum of P^{32} shows a Konopinski-Uhlenbeck distribution [see Abstract 3410 (1935)] practically to 8200 Hρ, but all tracks above 6950 Hρ could be accounted for by a spreading due to the estimated total error of 3·8 %; and the result seems to point to a sharp deviation from the K–U relation near the high energy limit, *i.e.*, above 6950 Hρ. The low energy part of the spectrum agreed with the K–U relation and showed no irregularities similar to those observed in the case of RaE [see Abstract 217 (1935)]. [For Part II see Abstract 12 (1937).] C. A. S.

968. Radioactivity of Co, Ni, Cu and Zn Induced by Neutrons. F. A. Heyn. *Physica*, 4. *pp.* 160–165, *Feb.*, 1937. *In English.*—The radioactivity of Co, Ni, Cu and Zn induced by neutrons of different energies is investigated. When bombarding Cu and Zn with fast neutrons, periods are observed which suggest that two neutrons are emitted by these nuclei. Experiments to confirm this presumption are described. AUTHOR.

969. Radioactivity Induced in Lithium by Neutrons. J. Veldkamp and K. S. Knol. *Physica*, 4. *pp.* 166–170, *Feb.*, 1937. *In English.*—The radioactivity induced in Li by neutron bombardment is studied. A saturated solution of $LiNO_3$ is activated in a vessel and is pumped along two counter tubes. There results a half period of 0·8 ± 0·2 sec., in accordance with measurements obtained with a rotating wheel. The processes involved in the formation of the radioactive element are discussed. AUTHORS.

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970. Attempt to Detect Radioactivity Produced by Positrons. G. P. Thomson and J. A. Saxton. *Phil. Mag.* 23. *pp.* 241–246, *Feb.*, 1937.—Various substances of small atomic weight have been bombarded by positrons in an attempt to detect induced radioactivity. No such effect was found. Some abnormalities in the behaviour of counters are noted. AUTHORS.

971. Deuterium-Protium Ratio in Normal Water. J. L. Gabbard and M. Dole. *Am. Chem. Soc., J.* 59. *pp.* 181–185, *Jan.*, 1937.—D_2-free H_2 has been prepared and combined with atmospheric O_2 yielding water lighter by 9 p.p.m. than Lake Michigan water. When 6·4 p.p.m. are added to 9 p.p.m. to correct for the difference in atomic weight of atmospheric O_2 and aqueous O_2, the density of D-free water containing normal O_2 is 15·4 p.p.m. lighter than normal water. From this the ratio of D atoms to H atoms in Lake Michigan water is calculated to be 1 : 6900. Our density value of $-15\cdot4\ \gamma$ agrees within 1·1 p.p.m. with that of Hall and Jones, $-16\cdot5\ \gamma$, and confirms their belief that the commonly accepted value for the D/H ratio is too high and should be revised downward. Our result indicates, however, that the downward revision should be somewhat more than that recommended by Hall and Jones. Isotopic exchange equilibrium constants involving D_2O^{16} and D_2O^{18} have been calculated and tabulated. AUTHORS.

972. Resonance Levels of Neutrons in Silver Nuclei. C. Y. Chao and C. Y. Fu. *Chinese J. of Physics*, 2. *pp.* 135–144, *Dec.*, 1936. *In English.*—By surrounding a photo-neutron source of Ra + Be with a thin spherical shell of paraffin, a continuous spectrum of scattered neutrons, extending from zero energy to the energies of the primary neutrons, is obtained. When a silver detector is exposed to such a spectrum, a part of the neutrons having just the energies at resonance with the Ag nuclei is strongly absorbed by the detector and thereby produces the induced β-activity. By measuring the activity of Ag and the apparent absorption coefficient of the resonance neutrons in a thin Ag absorber, the total width of the resonance levels effective to neutron capture and located in the above spectrum is estimated. Let Γ be the average value of one half of the half-value width of the resonance levels, expressed in volts, and n be the number of resonance levels here concerned. We find $n\Gamma = 260$ volts for the Ag nuclei of half period 22 sec. if the energies of the primary neutrons are taken to be 2×10^5 volts. Knowing $n\Gamma$, we can evaluate the average spacing between adjacent resonance levels effective to neutron capture by giving a plausible value to Γ. We find a spacing of the order 80–800 volts if Γ be given the value 0·1–1·0 volt. This result is in good accord with the recent theoretical calculation of Bethe and also with observations of resonance groups in the low energy region. AUTHORS.

973. Electron Emission from Substances Traversed by Fast Neutrons. S. Kikuchi, H. Aoki and K. Husimi. *Phys. Math. Soc., Japan, Proc.* 18. *pp.* 727–744, *Dec.*, 1936.—It is confirmed that the simultaneous discharges taking place in two thin-walled Geiger-Müller counters placed side by side near the target containing H^2 bombarded with H^2 are not due to stray γ-rays excited by neutrons in the different parts of the apparatus. It is also confirmed that the γ-rays are not emitted in the reaction of H^2 with H^2. As the result of absorption measurement, it is concluded that the electrons are emitted from the substances (so far, C, Al, Fe, Ni, Cu, Zn, Ag, Cd, Pt, and Pb, are investigated) traversed by the neutrons. The energy of the electrons is independent of the substances from which they are emitted, being about 1 mV. The cross-section of the process seems to increase with the atomic number, being of the order of 10^{-25} cm^2. for Al and 10^{-24} cm^2. for Pb. It is shown that there is no reasonable explanation of the observed effect in terms of nuclear process hitherto known. Some new types of interaction of the neutrons with the atoms are suggested. AUTHORS.

974. γ-Radiation at Neutron Capture. B. Pontecorvo. *J. de Physique et le Radium*, 7. *pp.* 511–513, *Dec.*, 1936.—A qualitative investigation, using a Geiger-Müller counter, of the constitution of the γ-radiation emitted by Au on the capture of slow neutrons is described. The composition of the γ-radiation, as given by absorption in Pb, is found to vary as the composition of the neutron beam is varied, by filtration with B. In the light of the ideas formulated by Bohr on the capture of slow neutrons, the results can be interpreted using the rules of selection. G. O. B.

975. Slow Neutrons. H. v. Halban, Jr. and P. Preiswerk. *J. de Physique et le Radium*, 8. *pp.* 29–40, *Jan.*, 1937.—A series of experiments has been carried out with neutrons retarded by paraffin, and their relation to previous theoretical and experimental work is fully discussed. A temperature effect is used to show that Cd is a strong absorber of neutrons, whose energy approximates to the thermal energy of the paraffin molecules, but not of neutrons of higher energy. The effects of other absorbers are dealt with, and a selective absorption effect is fully discussed. For these so called resonance neutrons of different elements a qualitative table is obtained giving their energies in order of magnitude. By means of this table it is shown that the effective cross-section of B for these resonance neutrons decreases with increasing neutron energy. The energies of resonance neutrons from different nuclei are found to lie between 1 and 200 V. The relation between Bohr's theory of nuclear levels and the results is fully discussed. A qualitative experiment demonstrates the diffraction of neutrons having a thermal energy. G. O. B.

976. Diffusion of Slow Neutrons in Hydrogenous Media. C. H. Westcott. *Cambridge Phil. Soc., Proc.* 33. *pp.* 122–136, *Jan.*, 1937.—The paper describes calculations on the distribution in space of slow neutrons based on the application of diffusion laws to their motions. The effects of using spheres of different sizes, and of changing the composition of the hydrogenous slowing-down medium, are discussed. Curves are given which can be compared with the results of the experiments on the slowing-down in different media carried out by the author and T. Bjerge [see Abstract 2794 (1935)], and a revision of the calculations based on these experiments leads to a value of 6×10^{-25} cm^2. for the total absorption cross-section of the water molecule, and indicates that most of this absorption must be attributed to the H atoms. [See following Abstract]. AUTHOR.

977. Absorbability in Cadmium of Neutrons Slowed Down in Water and Boric Acid Solutions. C. H. Westcott. *Cambridge Phil. Soc., Proc.* 33. *pp.* 137–139, *Jan.*, 1937.—Measurements have been made on the proportion of the effect induced in Ag which is due to neutrons strongly absorbed by Cd, using cylinders of water and boric acid of different sizes to slow down the neutrons. In addition to furnishing data for the foregoing paper [see preceding Abstract] the results show that practically all the neutrons of groups A and B must have energies greater than any of those of group C. AUTHOR.

978. Capture of Slow Neutrons in Hydrogenous Substances. W. E. Lamb, Jr. *Phys. Rev.* 51. *pp.* 187–190, *Feb.* 1, 1937.—A study is made of the effect of the chemical binding of the proton in hydrogenous substances on the capture of slow neutrons. It is shown that in contrast with the scattering cross-section, no change is made by this in the radiative capture cross-section. An estimate shows that the process of radiationless capture made possible by the binding will not play an important rôle. AUTHOR.

979. Direct Evidence on the Magnetic Moment of the Neutron. J. G. Hoffman, M. S. Livingston and H. A. Bethe. *Phys. Rev.* 51. *pp.* 214–215, *Feb.* 1, 1937.—An attempt has been made to observe the magnetic moment of the neutron through its selective scattering from magnetised iron. An experimental effect of 3·3 times the mean error has been observed. This effect agrees with that obtained from an evaluation of Bloch's theory. AUTHORS.

***980. Neutron Generator. A. Bouwers, F. A. Heyn and A. Kuntke.** *Physica,* 4. *pp.* 153–159, *Feb.,* 1937. *In English.*—A tube is described to produce high-speed ions and neutrons, and details on its performance are given. A description is given of a h.v. generator and a new method to supply the tension to the ion-source. AUTHORS.

981. Neutron-Proton Interaction. N. Kemmer. *Helv. Phys. Acta,* 10. 1. *pp.* 47–67, 1937. *In German.*—In a mathematical paper dealing with the theory of neutron–proton interaction, the dynamical system is described by means of a wave equation, based on the Dirac equation for single-body problems. The mathematical properties of this equation have been investigated. The proposed equation is only invariant when the spatial dependence of the interaction has the form of the δ-function. Considerable attention is paid to the question of the reciprocal effect at close distances of approach. In this case relativity corrections are shown to be appreciable. The calculations of Thomas on interaction are considered, and similar indications are found of the incompatibility of a standardised δ-function for the reciprocal action, with the finite binding energy of deuterons, so that a satisfactory description of the neutron–proton interaction as action at a close distance seems hardly possible. G. O. B.

982. Adjacent Charge Rule and the Structure of Methyl Azide, Methyl Nitrate, and Fluorine Nitrate. L. Pauling and L. O. Brockway. *Am. Chem. Soc., J.* 59. *pp.* 13–20, *Jan.,* 1937.—The investigation of methyl azide, methyl nitrate, and fluorine nitrate by electron diffraction is shown to lead to configurations of the molecules corresponding in each case to resonance between two important valence-bond structures. The unimportance of a third otherwise reasonable structure for these molecules as well as for N_2O is ascribed to instability due to the presence of electric charges of the same sign on adjacent atoms. It is shown that the differences in chemical properties of covalent and ionic azides and nitrates can be correlated with differences in structure. The use of the adjacent charge rule is illustrated by its application in the discussion of the structures of N_2O_5, N_2O_4, and the oxygen acids of heavier atoms. AUTHORS.

983. Long Chain Organic Compounds. K. H. Storks and L. H. Germer. *J. Chem. Phys.* 5. *pp.* 131–134, *Feb.,* 1937.—A layer of lard deposited upon a metal surface gives an electron diffraction pattern consisting of segments of diffuse inclined bands. These arise from line gratings made up of long hydrocarbon chains. The mean inclination of the axes of these chains to the surface normal is calculated to be 27°, and the separation of carbon atoms 2·50 Å. The saturated glyceride, tristearin, yields a diffraction pattern of diffuse bands parallel to the surface, unlike the diffraction pattern from lard, although the latter is predominantly a mixture of glycerides. We believe that the inclination of the long hydrocarbon chains in lard is due to lack of saturation, although this hypothesis has not been tested. Diffraction patterns from stearic acid deposited upon a metal surface also contain inclined bands. These are relatively well defined, and have inclinations which differ from one sample to another. This variation is attributed to the existence of large crystals the *c* axes of which are differently inclined to the plane of incidence. We calculate that this axis is always inclined 33° to the surface normal. A similar investigation of methyl stearate yields the angle 25°. For both stearic acid and methyl stearate the separation between diffraction bands corresponds to the atomic space 2·50 Å. This is in good agreement with the known distance between alternate C atoms in a zigzag hydrocarbon chain. AUTHORS.

See also Abstracts **1045, 1147, 1148, 1150, 1151, 1219, 1222, 1226, 1285, 1328, 1344, 1390.**

COLLOIDS.

984. Stability of Mixtures of Similarly Charged Sols. H. R. Kruyt and C. A. Nierstrasz. *Kolloid Zeits.* 78. *pp.* 26–31, *Jan.*, 1937. —A few sol mixtures are examined, in which the stability changes of both sols separate from each other can be followed. The effect of AgI sols on Au and congo-ruby sols is put down to the presence of the strongly peptising KI on both these sols. The effect of AgCl sols on Au sols can likewise be put down to the coagulating effects of KCl. The stabilising action of ZnO sols is shown to be dependent on the mode of formation of these sols and to the excess of alkali in the liquid. It is thus shown that the influence of similarly charged sols on one another can in the main be made reproducible by the addition of the corresponding electrolyte solutions. J. K.

985. Electrophoresis of Silver Iodide Sols. H. R. Kruyt and G. E. van Gils. *Kolloid Zeits.* 78. *pp.* 32–40, *Jan.*, 1937.—The effect is investigated of the addition of Th salts on electronegatively charged AgI sols after the addition of ions, potentially determined and non-determined. The Th figure is then calculated. It rises sharply by the addition of KI; it is slightly decreased by KNO_3. J. K.

986. Electrophoretic Concentration of Graphite Suspensions. E. Hoffmann. *Kolloid Zeits.* 78. *pp.* 105–106, *Jan.*, 1937.—A method is developed for the concentration of aqueous suspensions of graphite so as to avoid the use of HCl. An apparatus is constructed in which the suspension is not deposited directly on the anode, but a ceramic cylinder is placed round the anode, and rotated during the deposition. By these means the graphite can readily be removed from the suspension. The effects of the concentration of the electrolyte, the amount of stabiliser present on the deposition of the graphite are determined. F. J. B.

987. Structure of Iron Phosphate Sols. I. B. Revut. *Acta Physicochimica*, 5. 5. *pp.* 679–690, 1936. *In German.*—The structure of $FePO_4$ sols is investigated on the basis of coagulation experiments and pressure-viscosity measurements. The $FePO_4$ sols resemble in many ways the $Fe(OH)_3$ sols. The formation of coagulation structures is hastened by electrolytes, the more the kations and anions are hydrated.

The pre-heated $FePO_4$ sols show also striking differences from $Fe(OH)_3$ sols as the chief hydrolytic end-product is the strongly coagulating H_3PO_4. J. K.

988. Elasticity of Gelatin. J. H. C. Merckel. *Kolloid Zeits.* 78. *pp.* 41–50, *Jan.*, 1937.—Poole's method [see Abstract 19 (1926)] is applied to the study of cylindrical test-pieces under tension. Although, as noted by Poole, there is a creep effect, this is shown to proceed at a constant rate over wide ranges of load; moreover, equal increases in load produce equal initial increases in extension and it is thus possible to derive values of Young's modulus. The experimental studies cover (i) elasticity as function of added electrolytes (20 % gel in all cases); (ii) as function of gel concentration (15–32·5 %) in the absence of electrolytes; (iii) of *p*H over the range 0·2–11·2 (20 % gel). (i) With additions containing the common kation Na the extension/load increases regularly with the lyotropic number N of the anion. N is related to the concentration C giving some standard extention/load ratio by a bilinear expression of the form $NC + \alpha N + \beta C + \gamma = 0$. No regular relation could be found comparing additions with a common anion Cl^1 and varying kations. (ii) A similar bilinear relation exists between elastic modulus and gel concentration. (iii) With increasing pH, elasticity rises rapidly over the pH range 0·2–1·0 and then less rapidly to a maximum value, which is virtually constant from pH 5·0 to 11·2. L. V. C.

989. Hydrophilic Properties of Cellulose. Part III. K. Kanamaru and T. Nakamura. *Kolloid Zeits.* 78. *pp.* 83–87, *Jan.*, 1937.—As a consequence of the electronegative properties of cellulose it can select kations from aqueous solutions of electrolytes, in particular those with polyvalent kations, *e.g.*, Al or Th, and reacts with them to fix them in the form of metallic hydroxides. Thus the electropositive metallic hydroxides can be absorbed by the cellulose to a definite amount. The present work seeks to establish whether the hygroscopic or hydration capacity of the cellulose alters with the lowering of the electronegative charge or with the raising of the electropositive charge above the saturation point of the charging the adsorption of the $Al(OH)_3$ is altered. The decrease of the electronegative charge with the gradual increase of the $AlCl_3$ solution added, proceeds until the neutral point is reached where we have the minimum hygroscopic behaviour and the maximum breaking strength. On further increase of the Al salt the charge of the cellulose becomes positive and the hydrophilic and hygroscopic properties become stronger, whilst the breaking strength becomes less. The author's theory is claimed to define the hydrophilic properties of the cellulose definitely. [For Parts I and II see Abstract 452 (1937).] S. G. B.

990. Synæresis. W. Heller. *Comptes Rendus,* 204. *pp.* 43–45, *Jan.*, 1937.—Synæresis is defined as the spontaneous separation of a colloid system into two phases, a coherent gel and a liquid. It is classified into three varieties: (1) Synæresis by reduction in swelling, the initial gel consists of hydrophile particles, the dehydration of which gives rise to the liquid. (2) Synæresis by agitation; the initial gel forms geloids [see Abstract 953 (1936)], which if of density sufficiently > that of the liquid from which they are formed, separate as a gel by gravity or on centrifuging, but if of approximately the same density, or the liquid is too viscous, form an emulsion (coacervation). (3) Synæresis by contraction; the initial and final systems are both uniformly liquefiable gels with a network of geloids, which, once formed, continues to evolve and become more dense, the solidification being apparently accompanied by an increasing tendency to contraction. Synæresis is reversible if at the time of their first formation the colloid particles do not evolve further towards coagulation, the condition for reversibility being in fact the same as for thixotropy, and only distinguished therefrom by the concentration of colloid in the initial system. Irreversible synæresis is the counterpart of the thixolability of more concentrated systems; it is an intermediate stage between the thixolability of one part of the system and coagulation of another. C. A. S.

991. Effect of Ultra-Violet Rays on the Rhythmic Precipitation of Silver Chromate in Electrical Fields. S. Miyamoto. *Kolloid Zeits.* 78. *pp.* 23–26, *Jan.*, 1937.—If the reaction-tube is illuminated by u.v. light the width and the formation of the growing silver chromate precipitates are suddenly diminished and the precipitate is much darker in colour than the precipitate obtained in the absence of light. It is shown that the observed decrease in width and formation of the silver chromate precipitates is not primarily due to u.v. action. The influence of u.v. light on the rhythmic precipitation of silver chromate in gelatin is explained on the assumption that the illumination has an influence on the reaction between $K_2Cr_2O_7$ and gelatin and that the reaction-product formed influences strongly the rhythmic precipitation. J. K.

992. Mechanical Properties of Fibres and Films Formed from Cellulose and Cellulose Derivatives. E. Guth and S. Rogowin. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 7–8. *pp.* 531–547, 1936.—A review of the various mechanical and physical constants of films and fibres from cellulose and its derivatives and their relationship to theory and to each other. A schematic diagram of the structure is given showing the micellar orientation and the hexagonal linkages. The degree of orientation, the side-linkages, the formation of cellulose esters and the building up of compounds by solution and plasticisers, the conditions for the formation of films and fibres, with the influence of heat on the structure of the fibres, are dealt with theoretically. Tables showing the relationship of orientation to strength and to the modulus of elasticity are given. The relationship of moisture content to elasticity, and the amount of esterification to strength as also the effect of temperature are illustrated by numerical data. S. G. B.

See also Abstracts 1366, 1367.

CRYSTAL STRUCTURE AND PROPERTIES.

993. Kinetic Basis of Crystal Polymorphism. M. J. Buerger. *Nat. Acad. Sci., Proc.* 22. *pp.* 682–685, Dec., 1936.—In the opinion of the author, heat motion is a wave motion among the atoms of a crystal and polymorphism is bound up with the mode of vibration of the major repetitive units (referred to as clusters) of the crystal structure. For a given temperature, constant pressure being assumed, there is a preferred mode or combination of modes of vibration leading to least vapour pressure, which requires the cluster to have a certain dynamic symmetry. Stable crystals form at this given temperature by the building up of a crystal structure which provides the required dynamic symmetry for the cluster. The dynamic symmetry of a cluster is not necessarily identical with its static symmetry but may be either higher or lower. It is proposed to test the theory by applying it to known one-component systems. [See following Abstract]. J. T.

994. General Rôle of Composition in Polymorphism. M. J. Buerger. *Nat. Acad. Sci., Proc.* 22. *pp.* 685–689, *Dec.,* 1936.—The structures assumed by a definite chemical compound in response to temperature changes have been discussed [see preceding Abstract]. In the present paper the author discusses the manner in which the structural types may be modified by changes in chemical composition. Attention is directed to the migration of the point of transformation between two modifications, and the general principle is enunciated that an extension will take place of the range of that modification which by reasons of space, coordination or otherwise, is best suited to house the foreign atoms. On this view, the presence of even slight traces of impurity may shift the transformation point so much that a phase type which is metastable for the pure compound is actually stable for the impure compound. J. T.

995. Generalisation of Bravais' Law. J. D. H. Donnay and D. Harker. *Comptes Rendus,* 204. *pp.* 274–276, *Jan.* 25, 1937.—The extension is expressed as follows: "The importance of a form (*pqr*) is inversely proportional to the area (*n*S) of a unit cell generally a multiple of the plane *pqr,* calculated as if the net-period were hexahedral, taking as the multiplicity of the unit cell the first order *n* of reflection of X-rays compatible with the symmetry of the space group." It is illustrated by details concerning orthorhombic S, garnet, pyrite and low temperature quartz. C. A. S.

996. Lattice-Theory of Alkaline Earth Carbonates. Part IV. B. Y. Oke. *Indian Acad. Sci., Proc.* 4*a. pp.* 667–674, *Dec.,* 1936.—The electrostatic parts of the elasticity constants c_{11}, c_{22} and c_{23}^{0} are calculated by the same method as used for aragonite. The nature of the " repulsive " forces is further completely determined by comparison with the observed value of c_{11}. The value of c_{23}^{0} is then determined and found to agree well with the experimental value. [For Parts II and III see Abstract 455 (1937)]. AUTHOR.

997. Lattice Energies, Equilibrium Distances, Compressibilities and Characteristic Frequencies of Alkali Halide Crystals. M. L. Huggins. *J. Chem. Phys.* 5. *pp.* 143–148, *Feb.,* 1937.—Constants in the Born and Mayer exponential expression for the repulsion between two ions have been recalculated. Using these, the lattice energies and equilibrium distances between ions have been recomputed, for alkali halide crystals. Expressions have been derived and tested for the calculation of the compressibility and the characteristic maximum infra-red frequency. The relation between these two quantities is shown to be approximated by an empirical equation proposed by Madelung. AUTHOR.

998. Theory of Crystal Structure Factors. K. H. Riewe. *Zeits. f. Krist.* 96. 1, *pp.* 85–86, 1937.—A further extension is made of the theory [see Abstract 458 (1937)], dealing with the influence of the outer form of a crystal on the interference phenomena. In the present paper expressions are derived mathematically for the case of a rectangular parallelepiped. J. I.

999. Structure of Crystals. U. Dehlinger. *Die Physik,* 5. 1. *pp.* 9–22, 1937.—A critical survey of papers dealing with crystal structure which have appeared from Jan. 1933 to about July, 1936, continuing previous work [see Abstract 2129 (1933)]. D. R. H.

1000. Structure of Metallic Films. S. R. Swamy. *Indian Acad. Sci., Proc.* 4*a. pp.* 656–660, *Dec.,* 1936.—The structure of films of Au and

Ag obtained by evaporation *in vacuo* has been studied by electron diffraction methods. Direct evidence has been obtained for the existence of these metals in the amorphous state as suggested in an earlier paper by the author [see Abstract 1567 (1935)]. Films of Au and Ag which are thin enough to scatter light, as discussed in the earlier paper, are found to give electron diffraction patterns corresponding to an amorphous structure. Thicker films having metallic reflection and high electrical conductivity give patterns corresponding to a polycrystalline structure. AUTHOR.

1001. "Extra" Spots in Electron Diffraction Patterns. V. A. Kolpinsky. *Phys. Zeits. d. Sowjetunion,* 10. 4. *pp.* 563–564, 1936. *In English.*—The author claims that the "extra" spots observed by Brück [see Abstract 2977 (1936)] in the patterns afforded by thin single crystal films of Ag, Ni and Au, can be explained in terms of the Finch-Wilman effect. The crystal thickness in the direction parallel to the electron beam is so small that successive members of a given family of crystal planes do not contain the same number of atoms, and can no longer be regarded as equivalent. This results in the effective plane spacing being trebled, and diffractions $h/3$, $k/3$, $l/3$ are therefore easily explained. It is suggested that the Finch Wilman effect would give rise to these diffractions if the metal films consisted of regularly arranged pyramids or octahedra three atoms in height. A. G. Q.

1002. Structures of Cr_2Al and Cr_5Al_8. A. J. Bradley and S. S. Lu. *Zeits. f. Krist.* 96. 1. *pp.* 20–37, 1937. *In English.*—In the Cr-Al system eleven phases were found of which the structures of Cr_2Al and Cr_5Al_8 have been determined. Cr_2Al is tetragonal with six atoms in the unit cell, which consists of three body-centred cubes above one another, two planes of Cr atoms alternating with one of Al; space group D_{4h}^{17} (14/mmm.). But an alloy made up of that composition always contains two phases, the Cr_2Al being mixed with the solid solution of Al in Cr of which the structure is body-centred cubic. Cr_5Al_8 has a structure resembling that of Cu_5Zn_8 (γ brass) but more complicated. It is rhombohedral and only pseudo-cubic, the unit cell has a 7·7894 Å, 109° 7·6′ and contains 26 atoms, the positions of the Cr and Al atoms being quite different from those of Cu and Zn. The structure is figured and described in detail. C. A. S.

1003. Structure of Alkali Ferrihexafluorides. W. Minder. *Zeits. f. Krist.* 96. 1. *pp.* 15–19, 1937.—Details are given for the salts M_3FeF_6 (M = Li, Na, K, Rb, Cs and NH_4). Only the NH_4 salt is obtainable in distinct crystals, the others as powders. The structure of the NH_4 salt appears to be somewhat different from that of the others which are truly isomorphous among themselves. C. A. S.

1004. Rotation of Nitrate Groups in Cubic Crystal Lattices. C. Finbak and O. Hassel. *Zeits. f. phys. Chem.* 35. *Abt.B.* 1. *pp.* 25–28, 1937.—The authors' work on the rotation of anion polyhedra [see Abstract 2989 (1936)] is extended to the case of the cubic high temperature modifications of the nitrates of Rb, Cs, Tl and NH_4. The rotations of the nitrate ions in these salts are discussed and consideration is given to the case of $RbNO_3$, in which a further transition to a trigonal modification takes place at 219° C. The mechanism of this change is to be dealt with in another paper. J. T.

1005. Distorted Quartz Crystals. G. Laemmlein. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 4. 6. *pp.* 279–282, 1936. *In German.*—According to Bernauer every material, under suitable conditions, can crystallise in forms passing insensibly from normal to spharo crystalline. Owing to its crystalline system, distorted quartz is more difficult to investigate than the simpler dolomite. Usually the *a* axis is lengthened and the crystals stratified as $10\bar{1}0$ prisms, giving a drill-like crystal. Occasionally normal crystals have the *c* axis extended, the latter also acting as axis of the cylindrical spiral resulting. Well-developed crystals from the Urals show cylindrical twisting on the $\bar{1}2\bar{1}3$ plane, with facets. It is suggested that the six $\bar{1}2\bar{1}3$ planes are the key to all distortion in quartz crystals, and the investigation is developed theoretically. In the limit, cylindrical spiral crystals (curved surface $10\bar{1}0$, axis of spiral $\bar{1}2\bar{1}3$, direction of tip 0001) and augur crystals (curved surface $10\bar{1}0$, axis and direction of tip $1\bar{2}01$) are formed, the latter occurring in Switzerland. By HF etching, confirmatory information is obtained. D. R. H.

1006. Relation between Displacement Velocities of Faces of a Growing Crystal and its Boundary Elements. E. Ernst. *Zeits. f. Krist.* **96.** 1. *pp.* 38–77, 1937.—The rates of growth of the (001), (111), and (210) faces of NaCl from spherical pieces cut from a crystal of rock salt were determined by measuring the distance, 2Z, between pairs of opposite parallel faces of the same form as they grew in a supersaturated solution. These distances are expressed in the form $Z=a+bt+ct^2+dt^3$ (a, b, c, d constants, and t time since growth began). In similar fashion lengths of edges (K) and areas of surface (J) between, and of, the various forms were determined, and from Z the displacement velocities (v) for the various forms were deduced. The variations are expressed in curves and tables, and minute details of method, precautions, etc., are given. The changes in v and their connections with the other quantities according as the growth of the spheres into polyhedral crystals proceeds are discussed in great detail, and previous work on the subject criticised. C. A. S.

1007. Velocity of Crystallisation and Number of Crystallites of Pb with Small Additions of Te, Li and Mg. E. Jenckel and C. Thierer. *Zeits. f. Metallkunde*, **29.** *pp.* 21–24, *Jan.*, 1937.—The addition of small amounts of Te, Li and Mg to pure Pb displaces the velocity of crystallisation-temperature curves to lower temperatures; in the case of Li and Mg, the curves are much flatter. The number of crystallites increases at first at the same temperature, reaches a maximum, decreases and again appears to increase as the additions are gradually increased. H. J. H. S.

1008. Colouring of Fluorite and Rock-Salt. Elfriede Eysank. *Akad. Wiss. Wien, Ber.* **145.** 2*a.* 6. *pp.* 387–406, 1936.—Measurements of the absorption spectra of a number of different coloured fluorites between 350 $\mu\mu$ and 660 $\mu\mu$ before and after radium dosage show that in this region in general there appear two strong maxima, one at 575 $\mu\mu$ to 650 $\mu\mu$ and the other at 380 $\mu\mu$ to 405 $\mu\mu$. The varying relative strengths of the two bands account for very great differences in the colour of the fluorites. The displacement of the long-wave band towards the blue after long radium dosage or by pressure has been observed. No effect on the absorption curves of synthetically prepared CaF_2 or adding rare earths could be discovered and similarly with NaCl. An artificially prepared crystal of NaCl coloured more quickly than a natural one. The absorption spectra of artificial and natural NaCl crystals before and after radium dosage are shown. J. E.

1009. Quantum Efficiency of Colouring of Rock-Salt by X-Rays, β- and γ-Rays. I. Leitner. *Akad. Wiss. Wien, Ber.* 145. 2a. 6. *pp.* 407–423, 1936.—The number of colour centres produced per quant of X-rays of wave-length 0·38 Å has been estimated at 10^4 to 10^5 and by β- and γ-rays at 10^2 to 10^3. In spite of the uncertainty of these numbers it appears to be certain that high frequency quants colour largely by the aid of secondary radiation. The high efficiency of X-ray colouring is said to be explicable only on the assumption that the centres are ions to which electrons are more loosely bound than to the ions of the lattice. It is considered that the result of Burbidge, that each β- or γ-ray contributes only one electron to the photoelectric saturation current, shows, in conjunction with the above results, that the colour centres play a very small part in photoelectricity. J. E.

1010. Elastic Limits of Photochemically Coloured NaCl Crystals. M. N. Podaschewsky and A. M. Polonsky. *Phys. Zeits. d. Sowjetunion,* 10. 4. *pp.* 531–539, 1936. *In German.*—The elastic limits (determined by photoelectric means) of carefully annealed NaCl crystals after irradiation by weak X-rays are low, whilst those determined by an optical method are appreciably higher after intensive photochemical coloration with X-rays or u.v. radiation. Photoelectric and optical measurements are performed on the same crystal and it is found that crystals subjcted to weak X-rays exhibit discontinuities in the photoelectric current with time whilst those subjected to u.v. radiation show no such discontinuities. It appears that there is no direct relation between the results given by the two methods; this may be accounted for by a difference in the mechanism of colouring. The mechanism in each case is discussed. H. J. H. S.

1011. Breaking-Strain Experiments on Rock-Salt. W. Burgsmüller. *Zeits. f. Physik,* 103. 9–10. *pp.* 633–670, 1936.—Experiments are made on the purest crystal and also on crystals containing foreign atoms or molecules which either (1) form mixed crystals (2) are merely absorbed or (3) mix partially. At low temperatures, below – 190° C., the breaking strain decreases with increasing percentage of the foreign material, and is practically independent of temperature. Plasticity increases with increasing quantities of foreign material. The cohesion, at low temperatures, of purest rock-salt free from strains, is about 600 gm./mm.^{2} for a speed of working of about 6 gm./mm.^{2}/sec. Breaking strains and cohesions are also measured in high vacua. Re-adsorption of air as SO_2 causes a return to the original values. There is an appreciable lag in this change, and thus the change appears to be connected with capillary effects. The results are discussed in the light of other knowledge concerning mosaic crystals. G. G.

1012. Temperature Variation of Tensile Strength of NaCl. K. Krügel. *Zeits. f. Physik,* 104. 3–4. *pp.* 194–196, 1937.—The tensile strength of single crystals of synthetic NaCl is determined at temperatures between room-temperature and 500° C., readings being taken at intervals of 25°. The force is applied at right angles to the cube face. The tensile strength increases regularly with temperature up to 350° C. Above this temperature fluctuations are found, which are accompanied by necking and lattice rotation. These fluctuations are due to the alterations in plasticity caused by lattice diffusion. J. T.

1013. Isotropic Planes in Cubic Crystals. G. Aksenow. *Techn. Phys., U.S.S.R.* 3. 11. *pp.* 982–986, 1936. *In German.*—The elastic coefficients of a cubic crystal are calculated for different directions in the

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crystal by tensor analysis. Directions at right angles to the faces of each crystal form are isotropic and models are illustrated which are designed to show this. J. T.

***1014. Theory and Design of Cam of an Oscillating Crystal X-Ray Spectrograph. S. H. Yü.** *Zeits. f. Krist.* **96.** **1.** *pp.* 1–6, 1937. *In English.*—The author discusses the problem of transmitting the uniform angular velocity of a motor to the oscillating motion of a crystal holder. The theory is worked out of the design of a cam which when rotated one revolution will cause an arm to oscillate between two extreme positions with uniform motion and through a specified angle. Equations involving measurable constants are given for the construction of the curves and a diagram is reproduced of curves for cams giving oscillations of 5°, 10°, 15° and 30°, when the constants of the spectrograph are of specified values. The numerical data used in constructing the curves are given in two tables and curves for constants other than those used can be obtained by enlarging or reducing the given curves. It is pointed out that as the angle of oscillation becomes large the curves become markedly asymmetrical. J. I.

1015. Application of the Debye-Scherrer Method of X-Ray Crystal Analysis. W. Hume-Rothery and P. W. Reynolds. *Inst. of Metals, J.* **60.** [10 *pp.*] 1937. *Advance Copy.*—The application of the Debye-Scherrer method to the study of alloys is discussed critically with special reference to errors due to uncertainty of the exact composition of the filings comprising the specimen. It is concluded that where practicable it is desirable to analyse the actual filings from which the representative small sample used in the preparation of the specimen has been sieved. Methods are described for the preparation of perfectly clean filings suitable for accurate chemical analysis. It is shown that, in the determination of phase boundaries from lattice spacing measurements of two-phase alloys, misleading results may be obtained if the temperature of the preliminary anneal of the material in lump form is not suitably related to that of the final annealing of the filings. AUTHORS.

1016. Development of Crystal Analysis. W. H. Bragg. *Roy. Soc. Arts, J.* **85.** *pp.* 228–241, *Jan.* 22, 1937.—Several applications of crystal analysis are described showing the types of results that are being obtained at the present time. In connection with the use of Fourier series the method is illustrated by the Fourier diagrams for oxalic acid and phthalocyanin. The accuracy of the measurements is also discussed. The application of crystal analysis to proteins and to the structure of alloys is next described and finally the author gives a summary of recent work on the texture of crystals and also mentions several applications of crystal analysis to industrial problems. J. I.

See also Abstracts **983, 1080, 1197, 1264, 1277, 1279, 1295, 1299, 1337, 1341, 1349, 1356, 1358, 1362, 1364, 1390.**

DENSITY.

1017. Density of Liquid Selenium. S. Dobiński and J. Wesolowski. *Acad. Polonaise Sci. et Lettres, Bull. No.* 8–9 *A. pp.* 446–450, *Oct.–Nov.,* 1936. *In English.*—A short account is given of some preliminary determinations of the density of liquid Se for the temperature range 228–345° C. A quartz plummet, partly filled with mercury, is suspended in liquid Se from one arm of a balance, the Se being contained in a glass vessel enclosed in an electrically heated oven which is maintained at any desired temperature by thermostatic control. The density *d* may be accurately represented by the expression $d = 3{\cdot}987 - 0{\cdot}0016(t-220)$, where t is in °C. From density considerations alone the behaviour of liquid Se is quite regular, but further investigation of such properties as viscosity and dielectric constant is proposed. H. B.

See also Abstracts 971, 1206, 1275, 1283.

DIFFUSION AND OSMOSIS.

***1018. Semipermeable Membranes. A. Grumbach and P. Vidal.** *Comptes Rendus*, 204. *pp.* 237–239, *Jan.* 25, 1937.—To increase the strength of the membrane a layer of SiO_2 is deposited in the porous septum, which is of Schott glass, by alternate treatment with 10 % solution of Na_2SiO_3 and dilute H_2SO_4 (*d.* 1·21). After thorough cleaning, etc., $Cu_2Fe(CN)_6$ is then deposited as usual with various precautions described in detail. C. A. S.

See also Abstracts 976, 1291, 1303.

ELASTICITY AND PLASTICITY.

1019. Schwarz's Algorithm in the Theory of Elasticity. S. Soboleff. *Comptes Rendus (Doklady) de l'Acad des Sciences, U.S.S.R.* 4. 6. *pp.* 243–246, 1936. *In French.*—In the potential theory an algorithm permits the solution of the Dirichlet problem in a domain D_{12} which is the sum of two others D_1 and D_2 after having resolved successively this problem for each of the two domains. Michlin has given a similar procedure for the solution of the problem in the theory of elasticity but he established the convergence only in the case where the contours of the domain are sufficiently distant one from the other. In the present paper the problem of elastic displacements is considered and for a more extensive class of domains, D_1 and D_2, the convergence of the two preceding algorithms is established. R. S. R.

1020. Theory of Strength of Materials. L. Beschkine. *Comptes Rendus*, 204. *pp.* 228–230, *Jan.* 25, 1937.—The following problem is discussed: Given an isostatic or hyperstatic system, determine the relations between the displacements of various points of the system and the acting forces, when the displacements are sufficiently large to prohibit confusion between the initial and strained states of the system. The problem is of importance in the discussion of the strains occurring in a body having one of two dimensions small in comparison with the third. The treatment is here limited to the region in which Hooke's law applies. Castigliano's theorem is inapplicable; the general equation of de Fontvoliant can be extended to apply to this case. The necessary modification of this equation is discussed, and it is shown that the values of the fatigue functions to be inserted in the equation are those appropriate to the system when the displacements have attained half their final values. J. S. G. T.

1021. Rigidity of Vitreous Substances over their Softening Ranges. B. W. Derjaguin, A. A. Leontjewa and M. P. Wolarowitsch. *Acta Physicochimica*, 5. 5. *pp.* 617–626, 1936. *In German.*—The dynamic method of measurement described consists in casting a cylindrical shell of the substance between two coaxial cylinders, of which the outer is fixed and the inner forms part of a suspended system of high inertia, and determining the period of oscillation of the latter. Paraffin wax and a number of resins, etc., were studied; some showed such heavy internal damping that no oscillations could be produced, while with others there was evidence of slip on the cylinder surface. Rigidity moduli are given for rosin, guaiacum, glucose and Mendéeleff cement; the data for rosin, in conjunction with viscosity data, are held to throw doubt on the theory of relaxation oscillations. L. V. C.

1022. Effect of Temperature on Young's Modulus of Elasticity in Nickel-Copper Alloys. K. Nakamura. *Tohoku Univ., Sci. Reports*, 25. *pp.* 415–425, *Nov.*, 1936. *In English.*—The variation of Young's modulus of elasticity on eight specimens of Ni-Cu alloys of different compositions by heating is measured from room-temperature up to 500°. Below the Curie point Young's modulus of elasticity steadily decreases with the rise of temperature, when the content of Cu is less than about 13 % in weight, but on the contrary it increases, when the content exceeds the above percentage. Above the Curie point, the moduli of all the specimens decrease steadily with the rise of temperature, so that the modulus-temperature curves all show a sharp break at the Curie point. AUTHOR.

1023. Determination of Young's Modulus by Flexural Vibrations. G. Grime and J. E. Eaton. *Phil. Mag.* 23. *pp.* 96–99, *Jan.*, 1937.—The specimens were supported at the nodes on two pads, vibrations were excited by blows from a light hammer, detected by a small piezo-electric quartz and recorded with a kathode-ray oscillograph using a time scale of milli-sec. Young's modulus is given for rectangular bars, about 10 in. long, of lead, ebonite, wall board, paraffin wax, rock asphalt and asphalt mastic. [See also Abstract 3758 (1935).] G. E. A.

***1024. Photoelasticity-Stress-Type Quarter-Wave-Plate of a Large Field. Z. Tuzi and M. Nisida.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 676. *pp.* 99–107, *Jan.*, 1937. *In English.*—The physical properties of "Polaroid" are determined in detail and it is concluded that it is suitable for photoelastic experiments. A thick and large glass plate stressed uniformly was introduced in place of a usual mica quarter-wave-plate. It is found that such a plate serves well to produce circularly polarised light in a large field. AUTHORS.

1025. Free and Forced Vibrations of Elastic Systems. E. Sörensen. *Zeits. f. angew. Math. u. Mechanik*, 16. *pp.* 368–370, *Dec.*, 1936.—A differential equation is given for oscillating rods and it is pointed out that this is not easily soluble if the system is subjected to an external force. A special problem is considered of the oscillations of the circumferences of a group of vanes under centrifugal force and an approximate solution obtained. This method can be applied to other problems. H. M. B.

See also Abstracts 1061, 1394.

HYDRODYNAMICS AND AERODYNAMICS.

1026. Influence of Pressure on the Resistance of Objects Moving in Air. J. Luneau. *Comptes Rendus*, 203. *pp.* 1234–1236, *Dec.* 7, 1936.—For higher Reynolds numbers, the law of the proportionality between the resistance to the movement and the density of the fluid is verified within the limits of experimental error, taking account in calculating the density of the relation between the law of isothermal compression of air and the law of Mariotte. W. A. R.

1027. Hydrodynamic Field Around a Marine Screw. C. Chartier. *Comptes Rendus,* 203. *pp.* 1232–1234, *Dec.* 7, 1936.—Continuing his experimental researches [see Abstract 3333 (1933)] the author investigates the distribution of velocities around a screw for a given recoil. [See following Abstract.] W. A. R.

1028. General Flow Around a Screw. C. Chartier. *Comptes Rendus,* 203. *pp.* 1322–1324, *Dec.* 14, 1936.—It is found that down stream from a screw, whether acting as tractor or propellor, the flow has a helicoidal structure, whose periodicity is determined by the velocity of the water across the screw, and by the speed of rotation of the screw. [See preceding Abstract.] W. A. R.

1029. Heterogeneous Fluid Masses in Rotation. A. Gardedieu. *Comptes Rendus,* 204. *pp.* 98–101, *Jan.* 11, 1937.—For the purpose of studying the problems associated with fluid mass in rotation, it follows most conveniently from the equations to adopt the angular velocity as parameter, although previously Laplace and Liouville have taken the kinetic moment about the axis of rotation. The author now treats the case of heterogeneous fluid masses whose surfaces of equal density are ellipsoids of revolution by means of the angular velocity as parameter and starting from Véronnet's data. The cases of homothetic and homofocal ellipsoids are considered. The paper is entirely mathematical. H. H. Ho.

1030. Waves in Canals of Variable Depth. B. R. Seth. *Phil. Mag.* 23. *pp.* 106–114, *Jan.,* 1937.—The paper deals with transverse oscillations and investigates the gravest mode in three cases of canals of different cross-sections. W. A. R.

1031. Lateral Force on a Keel and Rudder. S. D. Daymond and L. Rosenhead. *Cambridge Phil. Soc., Proc.* 33. *pp.* 62–69, *Jan.,* 1937.—The two-dimensional flow of an inviscid fluid of density ρ, past an infinitely thin keel and rudder is investigated by the method of conformal transformation. An expression for the lateral force per unit depth of keel and rudder, γ, is derived in the form $\gamma = -\pi\rho l_2 U^2 \sin(\kappa\alpha + \beta)/\{\cos\frac{1}{2}(\alpha - \beta)\}^{1+\kappa}\{\cos\frac{1}{2}(\alpha + \beta)\}^{1-\kappa}$ where ρ is the density of the fluid, U the velocity of the undisturbed stream, l_2 the length of keel, $\sin\beta = \kappa\sin\alpha$, α being an acute angle occurring in the expression effecting conformal transformation to the z plane, and $\kappa\pi$ is the angle between keel and rudder. Numerical values of α, β and $\gamma/\pi\rho l_2 U^2$ are tabulated for values of the ratio of lengths of rudder and keel (l_1/l_2) equal to 0, 0·1, 0·2, 0·3, 0·4, 0·5 and ∞. Values of the lateral force determined by Cowley, Simmons and Coales [*Rep. and Mems. Advisory Council for Aeronautics,* 1916 (No. 253)] are consistently about 20 % above the theoretical values.

J. S. G. T.

1032. Compressible Fluid Motion. G. Hamel. *Forsch. IngWes.* 8. *pp.* 13–14, *Jan.–Feb.,* 1937.—For a compressible inviscid fluid, if the relation between the pressure, p, and density, ρ, were $p = p_0 - \alpha^2/\rho$ (p_0 and α positive constants), potential motions would be possible in which the equi-velocity-potential surfaces, $\phi =$ constant, are minimal surfaces, satisfying

$$\Sigma[\partial^2\phi/\partial x^2[(\partial\phi/\partial y)^2 + (\partial\phi/\partial z)^2] - 2(\partial\phi/\partial x)(\partial\phi/\partial y)(\partial^2\phi/\partial x\partial y)] = 0,$$

and the pressure satisfies the equation $p + \rho q^2 = p_0$, where q is the resultant velocity. S. G.

1033. Motion of a Vortex in the Angle between Two Plane Walls. W. Kucharski. *Forsch. IngWes.* 8. *pp.* 14–20, *Jan.–Feb.,* 1937. —The problem in the title is solved for a single line vortex (two-dimensional potential motion, inviscid fluid of constant density) with a line source or sink at the intersection of the planes. The equation of the path of the vortex is found explicitly. A vortex whose rotation is in the direction of the vorticity in the boundary layer at a wall will move away from that wall towards the plane of symmetry in the case of a source, and towards the wall in the case of a sink; and with this is connected, according to the author, the behaviour of a real fluid in a divergent or convergent channel. The differential equation of the path of the vortex (relative to the rotating walls) is also found if the solid plane boundaries are rotating about their intersection with constant angular velocity. Preliminary numerical studies of the equation show that the circumstances are very complicated; and that the vortex may now move away from the wall in convergent flow or towards the wall in divergent flow. Also there is, in general, a point (whose nature has not yet been studied) where the vortex can stay in relative rest, and the vortex paths all pass through that point. S. G.

1034. Motion of an Infinite Elliptic Cylinder in Fluids with Constant Vorticity. M. Ray. *Roy. Soc., Proc.* 158*A. pp.* 522–535, *Feb.* 3, 1937.—Following the method devised by Taylor [see Abstract 286 (1917)] the author discusses the motion of a perfect fluid of constant vorticity, in which a cylinder of any cross-section moves in any manner. It is shown that whenever the pure potential motion of the liquid for rotation of the cylinder, and the solution of a definite potential problem or the corresponding Green's function can be found, the result can be applied to calculate the motion of the cylinder in fluids with constant vorticity. The case of motion of an elliptic cylinder in a fluid moving with uniform shear motion is discussed in detail; when the fluid motion consists of uniform rotation, the results confirm Taylor's formulæ. J. S. G. T.

1035. Rotation Oscillations of an Unlimited Cylinder Filled with a Viscous Liquid. N. Slioskine. *Comptes Rendus*, 204. *pp.* 101–103, *Jan.* 11, 1937.—A method previously described [see Abstract 4998 (1936)] is now applied to the case of rotation of a body in a vessel filled with a viscous liquid, under the sole condition that the vessel and the body have the same axis of revolution. This method may be extended to the case where the moment of an external couple depends in a linear manner on the angle of rotation and on the angular velocity. The paper is entirely mathematical. H. H. Ho.

1036. Stability of Viscous Fluid Flow between Rotating Cylinders. S. Goldstein. *Cambridge Phil. Soc., Proc.* 33. *pp.* 41–61, *Jan.*, 1937.—The stability of the motion of viscous incompressible fluid of kinematic viscosity ν, between two infinitely long coaxial circular cylinders, of radii a and $a + d$ where d/a is small is investigated mathematically by the method of small oscillations. The inner cylinder rotates with angular velocity ω, the outer with angular velocity $\alpha\omega$, and there is a constant pressure gradient parallel to the axis. The fluid has a component velocity W parallel to the axis in addition to its angular velocity. A disturbance is assumed which is symmetrical about the axis and periodic along the axis. Reynolds' number is taken as $R = \overline{W}a/\nu$, l is the wave-length of the disturbance along the axis, $\sigma/2\pi$ the time period of the critical flow, and c the wave-length of critical flow. The analysis shows that putting $E = 2\omega^2\alpha^3\{a^2 - \alpha(a + d)^2\}/\{\pi^4\nu^2(a + \frac{1}{2}\alpha)\}$ and $s = (1 + \alpha)/2$, for given values of R, α, and l, it is possible to calculate σ and Es, and the value of l which makes Es a minimum can then be found. This least value of Es

gives the angular velocity for which the flow just becomes unstable. Values of l, Es, σ and ϵ are calculated for values of R between 0 and 25·84. The results are compared with those derived by Taylor and with the experimental results of Cornish ($a = 0$). The latter do not agree with the theoretical deductions. J. S. G. T.

1037. Production of Small Eddies from Large Ones. G. I. Taylor and A. E. Green. *Roy. Soc., Proc.* 158*A*. *pp.* 499–521, *Feb.* 3, 1937.—The dissipation of energy in turbulent flow has already been discussed [see Abstract 4101 (1935)] and empirical formulæ have been derived representing the grinding down of eddies, produced by solid obstructions, into smaller and smaller eddies. In the present paper the authors discuss mathematically this grinding down process in the case of a viscous incompressible fluid the initial motion of which is given by $u = \mathrm{A} \cos ax \sin by \sin cz$, $v = \mathrm{B} \sin ax \cos by \sin cz$, $w = \mathrm{C} \sin ax \sin by \cos cz$. The hydrodynamical equations are solved to a second approximation (a third approximation has been obtained). Expressions are derived for the mean rate of dissipation of energy $\overline{\mathrm{W}}$, and $\overline{\mathrm{W}}/\mu$ in the special case in which $a = b = c$; $\mathrm{A} = -\mathrm{B}$ and $\mathrm{C} = 0$; an expression for $\bar{u}_1^2$ is also derived. Numerical values of the respective functions are calculated for values of the Reynolds number equal to 20, 50, 100, 200 and 300, and the results are compared with experimental results representing the dissipation of vorticity in a wind channel. Satisfactory agreement between calculated and experimental results is obtained. J. S. G. T.

1038. Derivation of Coefficients of Orifices. W. E. Howland and J. D. Richetta. *Frank. Inst., J.* 223. *pp.* 83–94, *Jan.*, 1937.—Previous work on the derivation of coefficients is critically reviewed. The case of spherical surfaces, whose centres are not in the plane of the orifice, is worked out. Further study of the influence of the coefficient of velocity upon the coefficients of discharge and contraction is made, and a value for the coefficient of discharge only slightly larger than that obtained by experiments is deduced. W. A. R.

1039. Calibration Errors in Hydrometric Vane Current Meters. L. Escande and G. Sabathe. *Comptes Rendus*, 204. *pp.* 330–332, *Feb.* 1, 1937.—In continuation of previous work [see Abstract 69 (1937)], the authors have investigated the calibration errors introduced when vane current meters, used for determining water flow, are calibrated by being carried immersed in water at the end of an arm which rotates about a vertical axis. The percentage error found in two proprietary types of current meters was found to depend upon the radius of the circle traversed by them. Thus when the radius of the arm was 1·475 m. the error was about 3 %; with an arm of length 2·985 m. the error was about 1 %. The error introduced by proximity of the meter to the wall of the vessel containing water is small and negligible. The corresponding error due to decreasing proximity of the free surface of the water changes sign at a certain small depth of immersion. J. S. G. T.

1040. Aerodynamical Measurements in Small Wind Tunnels. B. Eck. *Zeits. f. techn. Physik*, 18. 1. *pp.* 14–20, 1937.—Describes the method of use of small wind tunnels of dia. 150 and 300 mm. and compares the results obtained with those given by tunnels of the usual size. Correction formulæ applicable in the latter case are no longer valid but otherwise the agreement is satisfactory. J. W. T. W.

✱1041. Aeronautical and Navigational Instruments. G. W. H. Gardner. *Journ. Sci. Instruments*, 14. *pp.* 52–56, *Feb.*, 1937.—A review of the exhibits in this class at the Physical Society's Exhibition, pointing out some of the directions in which development is especially desirable. Among the exhibits referred to in detail are a repeater compass for aircraft, an echo altimeter, an altimeter of the barograph type, a vertical speed indicator and two patterns of sextant. J. W. T. W.

See also Abstracts 1111, 1272, 1273.

KINETIC THEORY OF MATTER.

See Abstracts 952, 1291.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

***1042. Thermal Extensometer. I. Polevoy.** *Techn. Phys., U.S.S.R.* 3. 11. *pp.* 973–981, 1936. *In English.*—A thin-walled brass tube, fixed at one end, is heated by passing a current through a coil of fine insulated copper wire wound into good thermal contact with the tube. The consequent thermal expansion of the tube eventually causes its free end to make contact with a fixed metal stud, the moment of contact being indicated by some such auxiliary apparatus as a neon lamp. Variations of the distance between the two fixed points of the instrument, due to any external deformation, may be calculated from measurements of the resistance of the heating coil when contact occurs and a knowledge of the coefficient of linear expansion of the tube and the temperature coefficient of resistance of the coil. For a tube length of 50 mm. and a coil resistance of 40 ohms the sensitivity is 4 μ per ohm. Various applications are mentioned, particularly measurements of deformation of concrete structures and of rotating bodies, and determinations of the maximum amplitudes of vibrating bodies. H. B.

1043. Errors in Measurement of an Object by the Microscope. F. Ehrenhaft. *Comptes Rendus,* 204. *pp.* 40–41, *Jan.* 4, 1937.—Two particles identical in substance and size are separately measured visually or photographically in the field of a microscope. The particles are then moved together till they touch. The diametrical measurement at right angles to the line joining their centres gives a check on the first measurement; the difference between this and that along the line of their centres gives the correction to be applied to the measurement of single particles. H. G. C.

See also Abstract 1283.

MASS (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 1283.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

1044. Osculating Conic Sections and their Application in Practical Analysis and Kinematics. R. Beyer. *Zeits. f. angew Math. u. Mechanik,* 16. *pp.* 345–346, *Dec.,* 1936.—The equation of the conic section, more especially the ellipse, having 4- or 5-point contact with the curve $y = f(x)$ is deduced, and a process of numerical evaluation of the constants expounded. The method is explained by reference to a device for deriving the osculating ellipse associated with a hypocycloid. J. S. G. T.

1045. Evaluation of Integrals Occurring in Studies of Molecular Structure. C. A. Coulson. *Cambridge Phil. Soc., Proc.* **33.** *pp.* 104–110, *Jan.*, 1937.—A new method is developed for evaluating certain integrals occurring in molecular problems, where distances measured from three different centres of force are involved. The convergence of the results is discussed numerically and theoretically. AUTHOR.

1046. Integrals of MacCullagh's Equations. A. W. Conway. *Roy. Irish Acad., Proc.* **43***A. pp.* 25–33, *Jan.*, 1937.—The wave equations for the propagation of light in a bi-axial crystal are solved for the case of external conical refraction. It is shown that the solutions satisfy Fresnel's rules, although they are not plane waves. A more general class of solutions is obtained explicitly. R. P.

1047. Comparison of Series of Measures. H. Jeffreys. *Cambridge Phil. Soc., Proc.* **33.** *pp.* 35–40, *Jan.*, 1937.—To test the difference of the means of two series of measures of a quantity for a systematic difference a suitable test is given in terms of the theory of probability, it being supposed that in each series the probability of error is normally distributed with unknown standard error. The results obtained are applied by an approximate method to the mean systematic errors for a number of good seismological stations with vertical component instruments. R. S. R.

1048. Fundamental Magnitudes in the Study of Electromagnetic Phenomena. P. L. Kalantarov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* **4.** 8. *pp.* 355–358, 1936. *In French.*—The divergence between the dimensions of the same electric or magnetic magnitudes in the electromagnetic and the electrostatic Gauss-Weber "absolute" systems proves the incompatibility of these systems. Even when μ and κ are treated as fundamental magnitudes, in addition to L, T and M, dimensional formulæ retain fractional exponents, thus indicating that the choice of the fundamental magnitudes is erroneous. Maxwell's equations show that four fundamental magnitudes are necessary and sufficient for the expression of electromagnetic phenomena. The most rational system is obtained by treating as fundamental magnitudes length L, time T, magnetic flux Φ and quantity of electricity Q. This choice secures analogy between the dimensions of electric, magnetic and mechanical units. Mass loses the fundamental character hitherto attributed to it, and in purely mechanical problems, for which only three fundamental magnitudes are required, either action H ($= \Phi Q$) or energy W ($= HT^{-1}$) can be treated as fundamental, in addition to L and T. P. V.

1049. Electrical and Magnetic Units. L. Genillon and L. Roy. *R.G.E.* **41.** *pp.* 99–106, *Jan.* 23, 1937.—Replying to Roy [see Abstract 2554 (1936)], Genillon maintains that coefficients of proportionality must be inserted in each of the classical electromagnetic equations. These coefficients must satisfy certain relations imposed by the conditions of homogeneity, but there is no logical justification for regarding any three of them as more fundamental than the remainder. Suppression of the coefficients may be brought about by the choice of a single system of units, but one must separate out the numerical constants which are introduced into certain formulæ by the experimental conditions. L. Roy replies that coefficients of proportionality in defining equations are useless and unnecessary, and therefore need not be considered. L. H.

1050. Fundamental Units and Systems of Measurement. J. Wallot. *Die Physik*, **5.** 1. *pp.* 1–8, 1937.—A survey of events which have occurred since 1933 concerning the definition, determination, and rationalisation of units and systems of measurement. The following matters are those chiefly dealt with: The determination of the metre in terms of wave-lengths of light. The international decision to supersede the " international " electrical units by the " absolute " practical units. Standard resistances and cells. Photometric units. Dimensions and measuring systems. Magnetic units. Symbols. References to the original publications concerned are everywhere given. P. H. B.

1051 Bowl of Integers and the Hexlet. F. Soddy. *Nature*, 139. *pp.* 77–79, *Jan.* 9, 1937.—If two solid spheres of radius $\frac{1}{2}$ are contained in a hollow sphere of radius 1, the only possible arrangement is that the mutual points of contact are in the line of the diameter through all three centres. This arrangement is the " bowl of integers," and has the unique property that the bend (reciprocal of radius) of every sphere of the infinite number of spheres that can be packed into it, each being located by its neighbours, is an exact integer which can be written down from those of its neighbours. Following spheres of $r = \frac{1}{2}$ is a ring of six of $r = \frac{1}{3}$, the centres being at the corners of a hexagon, the simplest case of the hexlet. The scheme is developed in three dimensions for successively smaller spheres, the various hexlets being related to bends of successive groups of spheres. If the sum of the radii of the two largest spheres equals the radius of the enclosure the bends are always rational, and, when the largest two are equal in radius, integral with respect to the enclosure. General relations between the bends of the spheres are deduced from the quadratic equations for spheres in contact and properties of symmetry are discussed. N. M. B.

See also Abstracts 1019, 1031, 1312, 1334, 1361, 1371.

MECHANICS, CLASSICAL.

1052. Tension Curve in Revolving Discs with Eccentric Holes. F. Schultz-Grunow. *Zeits. f. angew. Math. u. Mechanik.* 16. *pp.* 366–368, *Dec.*, 1936.—Since practical cases occur in which the elastic theory of discs with holes along the radii are necessary, a method of successive approximations is developed and graphs are drawn to show the tensions at the edges of the holes. A numerical case is taken of a disc having two holes, a maximum increase of tension of 150 % is seen ; if more holes are added, the additional terms needed will be strongly convergent so that a solution may be obtained. H. M. B.

See also Abstracts 1088, 1301, 1372.

MECHANICS, QUANTUM.

1053. Interaction of Electrons. M. Schönberg. *N. Cimento*, 13. *pp.* 349–354, *Aug.-Sept.-Oct.*, 1936.—Starting from Dirac's idea that the interaction between electrons results from the action and reaction between these electrons and the quantised electromagnetic field, the paper gives a deduction of Møller's relativistic formula of interaction. A. J. McC.

1054. Criterion of Maximum Overlapping of Wave Functions. C. A. Coulson. *Cambridge Phil. Soc., Proc.* 33. *pp.* 111–114, *Jan.*, 1937.—The criterion of maximum overlapping, as developed by Pauling and Slater, is shown to be true only under certain conditions, depending on the relative positions of three term values, and the relation of the true energy to these three subsidiary ones is discussed in some detail. AUTHOR.

1055. Geometry of Microscopic Space. Part II. A. March. *Zeits. f. Physik*, 104. 3–4. *pp.* 161–168, 1937.—Continuing the discussion of his proposed geometry of microscopic space [see Abstract 516 (1937)], the author shows that it is essentially of statistical character and that it does not interfere with the description of the laws of nature by means of differential equations. The field-variables, however, are interpreted as average values and the definition of a wave motion ceases to apply in microscopic space. G. C. McV.

1056. Hypercomplex Numbers and a Relativistic Wave Mechanics. J. Roubaud-Valette. *Comptes Rendus*, 204. *pp.* 35–37, *Jan.* 4, 1937.—The method of Dirac, in which non-commutative hypercomplex numbers are used, is employed to factorise the wave-equation of Gordon. An uncertainty relation, $\Delta p . \Delta x = 5h/2\pi$, is deduced from the resulting first-order equation. G. C. McV.

1057. Angular Momentum in Wave-Mechanics. K. Bechert. *Ann. d. Physik*, 28. 2. *pp.* 199–208, *Jan.*, 1937.—The eigenvalues and eigenfunctions of the angular momentum and the selection rules for a system of particles without spin are deduced directly from the differential equations using the properties of Legendre functions. G. C. McV.

1058. Effect of Nuclear Motion in the Dirac Equation. I. S. Lowen. *Phys. Rev.* 51. *pp.* 190–194, *Feb.* 1, 1937.—Corrections to the Dirac equation, relativistic to the order v^2/c^2, due to the motion of the nucleus, for the case of an electron in the field of a heavy particle of mass M, are derived with the aid of the Breit two-body relativistic interaction, to the order m/M, m being the mass of the electron. A calculation of the value of the correction for a 1*s* electron gives a result in agreement with that obtained from the Schrödinger treatment to the order m/M. AUTHOR.

1059. Approximation to Discrete Quantum States by Iteration. L. H. Thomas. *Phys. Rev.* 51. *pp.* 202–205, *Feb.* 1, 1937.—A method is described by which successive approximations to the wave functions and energies of stationary states can sometimes be obtained in a form allowing definite limits of error to be stated. Two examples in which the solution is otherwise known are worked out and the rate of approximation is found to be rapid. AUTHOR.

1060. Statistical Thermodynamics Based on Quantum Mechanics in Hartree's Approximation. W. Kofink. *Ann. d. Physik*, 28. 3. *pp.* 264–296, *Feb.*, 1937.

See also Abstracts 981, 1064, 1151, 1194.

RELATIVITY AND ETHER.

1061. Effect of the Fitzgerald-Lorentz Contraction on the Frequency of Longitudinal Vibration of a Rod. A. B. Wood, G. A. Tomlinson and L. Essen. *Roy. Soc., Proc.* 158*A*. *pp.* 606–633, *Feb.* 3, 1937.—An experiment somewhat analogous to the Michelson-Morley experiment is suggested. In this experiment a rod in longitudinal vibration is rotated in a horizontal plane so that its length varies periodically by reason of the Fitzgerald-Lorentz contraction. Accurate measurements are made of the vibration frequency, which should vary with the length, if the length only is affected. Relativity theory, however, predicts that no change of frequency should be observed and that there should be a complete compensation of the contraction in length by a modification of the velocity of sound according to the orientation of the bar with respect to the direction of its motion. The experiment has been carried out with two similar longitudinal piezoelectric quartz oscillators, one rotating and one stationary, the relative frequency being measured. The methods adopted to attain the necessary degree of precision are described. The results fully confirm the prediction of the theory of relativity. The experiment yielded a null result within narrow limits of uncertainty of about ± 4 parts in 10^{11}, or less than 1 % of the estimated contraction due to the earth's orbital motion. AUTHORS.

1062. Non-Holonomic Unified Field Theory. G. Vranceanu. *J. de Physique et le Radium*, 7. *pp.* 514–526, *Dec.*, 1936.—A unitary field-theory is developed based on metrical geometry of five dimensions. The local space-time at each point is four-dimensional but the local space-times at all points are not tangent to the same four-dimensional space. Parallel displacement round a small circuit does not result in a return to the starting point but to a point on the normal to the local space-time of the starting point. The torsion-tensor so defined can be identified with the electromagnetic tensor whilst the four-dimensional curvature-tensor is identified with the properties of matter as in general relativity. Maxwell's and Einstein's equations can be deduced as well as the trajectories of charged particles, particular cases of which define the paths of light rays. G. C. McV.

1063. New Action Functions and the Unitary Field Theory. Part II. L. Infeld. *Cambridge Phil. Soc., Proc.* 33. *pp.* 70–78, *Jan.*, 1937. —There exists a group of action functions, depending on a parameter γ giving for every $\gamma \gg 0$ a static solution with central symmetry and finite energy, both for the electric and magnetic field, and going over into Maxwell's action function for weak fields. For $\gamma = 1$ we obtain Born's case distinguished by a perfect symmetry between electric and magnetic field. For $\gamma = 0$ the action function takes a particularly simple form and the comparison with the results of Heisenberg, Euler and Kockel allows of an approximate determination of the fine structure constant. [For Part I see Abstract 1059 (1936).] AUTHOR.

1064. Linearisation of Energy Density and the Action Function with the Help of Complex Vectors. Marie A. Tonnelat-Baudot. *Comptes Rendus*, 204. *pp.* 110–112, *Jan.* 11, 1937.—Linear expressions are deduced with the help of complex operators derived from Born's operators [see Abstract 1058 (1936)] and Schrödinger's complex vectors. N. M. B.

1065. Unitary Field Theory. K. Yano. *Comptes Rendus*, 204. *pp.* 332–334, *Feb.* 1, 1937.—Vranceanu has interpreted the types of space discussed by Kaluza, Klein, Einstein and Mayer, in their respective unitary field theories, as a non-holonomous hypersurface, V_5^4, in Riemannian space V_5 [see Abstract 3324 (1935)]. In the theory it is implied that all the Pfaffian coefficients ds^α ($\alpha, \beta, \ldots . = 1, 2, 3, 4, 5$) do not contain the variable x^5, that the Pfaffian coefficients ds^a ($a, b, \ldots . = 1, 2, 3, 4$) do not contain the differential dx^5, and that $G_{55} = 1$. These conditions are here derived in precise form. J. S. G. T.

See also Abstracts 1371, 1372.

SOLUTION.

1066. α-Boundary in the Copper-Zinc System. S. Konobejewski and W. Tarassowa. *Phys. Zeits. d. Sowjetunion*, 10. 3. *pp.* 427–428, 1936. *In German.*—From recent results the solubility of Sn in Cu decreases rapidly with falling temperature, in contradiction of previous ideas. The analogous question is investigated in brasses. Pure Cu-Zn alloys (Pb = 0·05 %) are soaked for 15 hr. at 700°–400° and filings from these are annealed for long periods (up to 2500 hr. for the lower temperatures) at 400°, 310°, 218°, 167° and 100° C. From the plot lattice constants against temperature the solubility can be determined. It is shown to fall from 38·75 % at 400° C. to 33·35° at 167° C., the boundary being convex to the axis Zn = 0 as in the Cu-Sn diagram. D. R. H.

1067. Solubility of Silver and Gold in Solid Magnesium. W. Hume-Rothery and E. Butchers. *Inst. of Metals, J.* 60. [6 *pp.*], 1937. *Advance Copy.*—The solid solubility of Ag in solid Mg is investigated above 300° C., and the solidus and solid solubility curves of the Mg-rich solid solution are determined. The maximum solubility of silver in Mg is 3·9 atomic % (15·3 % by weight) at the eutectic temperature (471° C.), and the solubility decreases with decreasing temperature to 0·9 atomic % (3·9 % by weight) at 300° C. The maximum solubility of Au in solid Mg is of the order 0·1 atomic % at 576° C., and the solubility decreases with decreasing temperature. AUTHORS.

1068. Constitution of Silver-Rich Antimony-Silver Alloys. P. W. Reynolds and W. Hume-Rothery. *Inst. of Metals, J.* 60. [10 *pp.*], 1937. *Advance Copy.*—The liquidus curve of the system Ag-Sb is determined accurately in the range 0–25 atomic % Sb. A new peritectic horizontal is found at 702·5° C., at which temperature the α solid solution reacts with the liquid to form the β solid solution which has a close-packed hexagonal structure. The phase boundaries of the α and β solid solutions are determined accurately at temperatures above 300° C. The general form of the diagram when drawn in terms of electron concentration resembles that of the system Ag-Sn. The critical points determined are examined from the point of view of Stockdale's theory of integral atomic ratios. AUTHORS.

1069. Solubilities of KCl in D_2O and H_2O. R. W. Shearman and A. W. C. Menzies. *Am. Chem. Soc., J.* 59. *pp.* 185–186, *Jan.*, 1937. —Values for the solubility of KCl in H_2O and in D_2O have been reported in the temperature range 0–180°. The differences in solubility are briefly discussed. AUTHORS.

1070. Kinetics of Countercurrent Absorption Towers. H. G. Littler. *Canad. J. of Research,* 14. *Sect. B. pp.* 430–443, *Dec.*, 1936.—The kinetics of countercurrent towers absorbing a gas which obeys Henry's law have been worked out by a more rigid method than that used by Donnan and Masson. An equation is obtained which, unlike the Donnan and Masson formula, is the expression of a process which is thermodynamically irreversible. This is in accordance with the requirements of thermodynamics. The theoretical variation of the concentration of the soluble gas in the two phases throughout the tower is examined by means of the new equation. AUTHOR.

See also Abstracts 1178, 1281.

SURFACE TENSION AND COHESION.

1071. Dielectric Potential and Surface Tension of Cholic Acids. B. Kamieński and J. Inglot. *Acad. Polonaise Sci. et Lettres, Bull. No.* 5–6*A. pp.* 248–254, *May–June,* 1936. *In English.*—The surface tension and the electrical potential at the solution-air interface of the cholic acids at different H-ion concentrations are measured. Since the direction of the change of the dielectric potential of the acid solutions is positive, it is impossible to conform this fact to the supposition that the anion of the acid is adsorbed. As H-ions are not adsorbed at the solution-air interface the change is effected by the unionised molecules. Thus, the former hypothesis of one of the authors is confirmed. The change of the surface tension and the dielectric potential are far from being proportional to each other in solutions of desoxycholic acid, dehydrocholic acid and glycocholic acid. These facts make it necessary to introduce into Gibbs' adsorption equation the term of the electrical potential perpendicular to the interface. [See following Abstract.] AUTHORS.

1072. Dielectric Potential of a Potassium Chloride Solution. B. Kamieński and J. Inglot. *Acad. Polonaise Sci. et Lettres, Bull. No. 5–6A. pp.* 255–257, *May–June,* 1936. *In English.*—The electrical potential at the solution-air interface of a 0·1 *N* KCl solution at different H-ion concentrations is measured. The H-ion concentration is established by the addition of HCl or KOH. The dielectric potential does not change in the pH range from 1·8 to 12·2. In very strong HCl solutions, however, a negative change of the potential was observed. In alkaline solutions a positive change was noticed. Assuming that the dielectric potential is an additive function of the action of the diluted solutions some deviations of the dielectric potential of cholic acid solutions were explained. [See preceding Abstract.] AUTHORS.

1073. Dielectric Potential and Surface Tension of Cinchonine and Cinchonidine Solutions. W. Goslawski. *Acad. Polonaise Sci. et Lettres, Bull. No. 7A. pp.* 370–377, *July,* 1936. *In English.*—The dielectric potentials and the surface tensions of the HCl solutions of cinchonine and cinchonidine are measured at different H-ion concentrations. A parallelism of changes of the dielectric potential and surface tension is found. Higher values for the dielectric potential in the buffer solutions, than in the KCl solutions, are obtained. AUTHOR.

1074. Surface Tension of Solutions of Electrolytes as Function of Concentration. G. Jones and W. A. Ray. *Am. Chem. Soc., J.* 59. *pp.* 187–198, *Jan.,* 1937.—The surface tensions T of aqueous solutions of KCl, K_2SO_4 and $CsNO_3$, from 0·0001 *N* up to 3 *N*, *N* and 0·1 *N* respectively, and of sucrose solutions from 0·0002 up to 0·005 *M*, were very carefully determined at 25° C. relative to water (surface tension γ) by a modification of the capillary-rise method. Errors associated with the capillary tube were eliminated by bringing all the menisci to the same point on the tube. Other sources of error were eliminated by the computation of the capillary rise from data obtained by weighing. An accuracy of 0·002 % in T/γ was obtained. For each salt $T/\gamma < 1$ for dilutions below about 0·006 *N* and the minimum value of T/γ, 0·9998, was observed at about 0·001 *N*. For sucrose T is linear with concentration at all dilutions. The data for the three salts are not in accord with the Onsager-Samaras equation which is regarded as over-simplified; and it is suggested that the cause of the diminished surface tension at extreme dilution is ionic in character, and probably due to an interaction between the ions and polarised water molecules. P. H. B.

1075. Surface Study of Ordinary Solutions. J. W. McBain, T. F. Ford and D. A. Wilson. *Kolloid Zeits.* 78. *pp.* 1–9, *Jan.,* 1937.—This very comprehensive paper examines the subject under the following headings: New application possibilities of the Pockels-Langmuir-Adam

ρ = density and d = internal diameter of orifice). When Z is plotted against the appropriate Reynolds number R, the points on the resulting diagram which are associated with jets of liquid shown by high-speed kinematography to possess screw symmetry, are confined between two parallel inclined lines. The band between these lines separates the points associated with streams showing plain axial symmetry from those associated with streams showing spray formation. R and Z are small for plain axial symmetry and large for spray formation. P. H. B.

1083. Extinction of Friction. L. Lecornu. *Comptes Rendus,* **204.** *pp.* **21–24,** *Jan.* **4, 1937.**—Referring to a paper by Appell published in 1905, the author discusses Appell's views and his own studies of that time and gives his present conclusions. At the beginning of sliding a certain amount of potential energy is stored up to be liberated at the beginning of rolling. First of all an assemblage of spheres having their centres fixed and affected by mutual friction is considered, and similarly a set of cylinders turning around parallel axes and subject to friction. Such phenomena occur in the movement of a billiard ball. The progressive rise of the axis of an oval body placed on a table is a somewhat special phenomenon. For this to occur the rotation must be very rapid. If the rotation is slow the axis tends to sink. Two limiting cases are then possible, either movement round a vertical axis or rolling on the table. But in the two cases all sliding is finally suppressed. If the external forces do not prevent there exists a quasi-permanent state in which the work absorbed by friction is reduced to the minimum compatible with these forces, the energy becoming constant, on the average, with more or less pronounced oscillations. As the work absorbed by friction is dissipated in thermal energy it may be said that friction is connected with the principle of the minimum of dissipation. J. J. S.

1084. Microviscometer for Non-Newtonian Liquids. G. W. S. Blair.** *Kolloid Zeits.* **78.** *pp.* **19–21,** *Jan.,* **1937.**—The liquid (0·5 cc.) is forced under constant pressure P out of an originally full capillary tube of length L; for Newtonian liquids $L^2 - l^2 = A\,Pt + B$, l being the length of tube remaining full at time t, A being proportional to the viscosity and B (usually negligible) depending on surface tension. The departure of the $(L^2 - l^2)$, t curve from linearity is an empirical measure of non-Newtonian behaviour of the liquid. ***Erratum, **ibid,** ***p.*** **231,** ***Feb.,*** **1937.** L. V. C.

See also Abstract 1292.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***1085. Twilight Performance of Telescopes. A. Kühl.** *Phys. Zeits.* 37. *pp.* 912–914, *Dec.* 15, 1936.—Since König's measurements of distinctness of vision it is known that it is also possible to express the twilight sharpness of seeing of the eye as a linear function of the logarithm of the strength of illumination of the image on the retina. From this as starting point the author gives a short discussion of the subject. Designating by L the performance of the telescope, and by Γ_a the twilight normal magnification of the telescope, and by V the super-normal magnification, the equation $L = \Gamma_a . V^{1/2}$ is reached: or expressed in words—the twilight performance of a telescope is the product of the twilight normal magnification (*i.e.*, the diameter of its objective in units of the twilight width of the pupil of the eye) and the square root of the super-magnification. It appears also that for each prism glass engraved the product $\Gamma.D$ has a clear physiological significance in relation to the twilight performance and it would therefore presumably be advisable to make the effective diameter of objective in this form also in the case of Galilean glasses. J. J. S.

See also Abstract 1094.

COMETS AND METEORS.

1086. Motion of Periodic Comet Kopff (1906*e*) (P. II). F. Kepiński. *Acad. Polonaise Sci. et Lettres, Bull. No.* 7*A*. *pp.* 327–344, *July*, 1936. *In English.*—The author uses the three apparitions of 1919, 1926, and 1932/33 (which latter yielded 83 observations in 8 months) to establish a new system of osculating elements (S_3) which, taking into account the perturbations of major planets (Jupiter, Saturn, Mars, Earth and Venus), should represent the 1919–1933 observations by the method of least squares. A. S. D. M.

COSMOGONY.

1087. World-Structure and the Sample Principle. Part II. G. J. Whitrow. *Zeits. f. Astrophysik,* 13. 2. *pp.* 113–125, 1937.—It is shown that further properties of Milne's simple kinematical system may be derived with the aid of Hubble's sample principle. Assuming that the system admits no fundamental constants of length or time it is found that Milne's postulate of the rectilinearity of all light-paths is automatically satisfied. It appears that, in general, the cosmological principle may be deduced *a posteriori* for any self-consistent universe in which local phenomena are everywhere the same. [For Part I see Abstract 3069 (1936).] AUTHOR.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

1088. Stellar Problem of Three Bodies. Part III. E. W. Brown. *Roy. Astron. Soc., M.N.* 97. *pp.* 116–127, *Dec.*, 1936.—Continuing his investigation of this problem [see Abstract 556 (1937)], the author discusses the motion of the apse and of the node of the orbit. Applied to the motion of the moon, the theory accounts for an outstanding difference of 17″ in the centennial motion of the lunar perigee. G. C. McV.

PLANETS.

1089. Stratification in a Non-Homogeneous Heavy Celestial Body of High Temperature. J. Geszti. *Gerlands Beitr. z. Geophys.* 49. 1–2. *pp.* 26–65, 1937.—The theory developed of the mixing of the earth's interior rejects the assumption of a drop-like accumulation and unimpeded sinking of ordinary materials to the heavier core. It is considered that the density layering proceeds in two or more steps and even in the outer layer, in the separation zone, by enormous spherical drop-form eccentrically layered mass inflows to the central regions. An indirect way is described to demonstrate the changes from the crust to the interior. The conclusions are in opposition to empiricism. The theory indicates the forces producing faulting of the earth's surface, the origin of geosynclines with disturbing masses in the interior of the earth, it offers a possibility for polar and strong crustal movements and for climatic changes, and provides an explanation for the periodicity of mass inflows to the interior and so provides a reason for repeated diastrophy or geological time sectioning. R. S. R.

1090. Materials and Density of the Earth's Crust. H. Jeffreys. *Roy. Astron. Soc., M.N. Geophys. Supplement,* 4. *pp.* 50–61, *Jan.*, 1937.—The normal structure of the continents is supposed to be represented by a layer of granite about 12 km. thick, upon an intermediate layer of uncertain and probably varying composition probably about 24 km. thick, underlain by a lower layer, mainly of olivine, extending without much change of composition or state to a depth of about 480 km. At this level seismic waves show a change of velocity, most easily dealt with as a sudden change and Bullen shows that this simplifies a jump of about 0·5 in density at this level. These statements and the evidence on which they are based and the probable nature of the materials are considered in the light of the depths adopted by Bullen and the author for the discontinuity layer. The effects of rise of temperature with depth, the constant of gravitation and the nature of the interface between the different layers on the values obtained are also examined. [See following Abstract]. R. S. R.

1091. Density Distributions in the Inner Planets. H. Jeffreys. *Roy. Astron. Soc., M.N. Geophys. Supplement,* 4. *pp.* 62–71, *Jan.*, 1937.—The results obtained for the earth [see preceding Abstract] have been applied to some of the inner planets mainly to test Bernal's hypothesis that a change of density about 470 km. deep in the earth represents a transition of olivine to a denser form under higher pressure. The hypothesis agrees well with data for the moon but the hypothesis that the transition is to a new material denser at all pressures fails. For Mars the density itself is not explained but agreement is obtained on assuming a small central core similar to that of the earth. The hypothesis of a new material for Mars fits the data but the amount required is too large. The former hypothesis gives, on the assumption of hydrostatic equilibrium, an ellipticity of Mars rather greater than the observed value, the second one rather less, but the differences are no more than those expected from the loads known to be supported by the strengths of the earth and moon. Values are given for the mean density of Mercury using Bernal's hypothesis. For Venus a solution is obtained but it provides no verifiable inferences. R. S. R.

1092. Periodic Variation in Colours of Jupiter's Two Equatorial Belts. A. S. Williams. *Roy. Astron. Soc., M.N.* 97. *pp.* 105–108, *Dec.*, 1936.—A continuation of publications in 1899 which gave a variation in colour of N.E.B. and S.E.B. of 12·98 yr., and in 1930 of 12·5 yr. but the observations of the last 6 yr. indicate a decided shortening of the period, so that the author concludes that it may now be definitely taken as 11·9 yr., in practical agreement with Jupiter's revolution round the sun, so that it indicates a seasonal effect, even though Jupiter's equator is very slightly inclined to the ecliptic. The elements of the standard epoch are 1838·52 + 11·86E yr.; at these epochs the N.E.B. is at or near a mimimum of redness and the S.E.B. a maximum; but at intermediate epochs the belt colours are reversed. The next computed standard epoch is 1945·2.

A. S. D. M.

1093. Possible Results of an Encounter of Pluto with the Neptunian System. R. A. Lyttleton. *Roy. Astron. Soc., M.N.* 97. *pp.* 108–115, *Dec.*, 1936.—Encounters of Pluto with the Neptunian system may eventually occur and may have occurred in the past. Their investigation throws some light on the anomalies at the edge of the solar system. Under Neptune's action Pluto cannot be ejected from the system, but the extent of its orbit may be greatly altered. If Pluto should encounter Triton several interesting cases arise, but these are of slight interest owing to their improbability. Nevertheless it appears from these considerations that Pluto may originally have been a direct satellite of Neptune, and that the encounter which gave it an existence as an independent planet also reversed the general direction of motion of Triton, thus giving a second, though rather speculative, possible explanation of the retrograde motion of a true satellite.

AUTHOR.

STARS.

1094. Influence of Limb Darkening on Interferometric Measurements of Stellar Diameters. W. Dünnweber. *Zeits. f. Astrophysik,* 13. 2. *pp.* 104–107, 1937.—The theory of the Michelson interferometer as used for determining stellar diameters is extended to cases where darkening occurs towards the stellar limb according to the law $i \propto 1 + \beta \cos \theta$, where β is the limb-darkening coefficient and θ the position angle on the disc of the point considered. The ordinary expression for the visibility of the interference fringes is emended to allow for darkening of this type, the new expression being evaluated by means of Bessel functions. For values of β between 0 and 10, the ratio of true to apparent diameter varies from 1·00 to 1·15.

A. Hu.

1095. Magnesium Hydride Bands in Stellar Spectra. Y. Öhman. *Astron. Iakttagelser och Undersökning, Stockholm, Obs.* 12. 8. [38 *pp.*], 1936. *In English.*—A continuation at Stockholm of the author's work at Mt. Wilson on CaH bands [see Abstract 4467 (1934)], through the MgH bands with heads at λλ5211 and 4845. He obtains on Eastman X plates also the MgH yellow-green band at λ5622, making the indentification of this certain in late dwarfs. By the Stockholm slitless spectrograph, M giants and dwarfs are separated by measuring the strengths of the TiO and MgH bands; these last are faint in early K stars, increase rapidly after K5 and reach their maximum intensity about M0; in late M dwarfs are somewhat fainter, and are probably present but weak in giants where also they have a maximum at M0. The short MgH spectra by the slitless spectrograph give a new method of detecting faint M dwarfs. He compares in detail the spectrum of a typical dwarf (61^2 Cygni) and giant (β Andr), both M0, and gives photometric curves, confirming the presence in M dwarfs of the MgH bands at $\lambda\lambda$5211 (0·0), 4845 (1·0) and the (0·1) band at 5622 of the same molecule. Evidence is given of a greater strength in dwarfs of the Mg lines 4703 (3^1P°–5^1D) and 5528 (3^1P°–4^1D) confirming the strengthening of the Mg triplet (3^3P°–4^3S). A photometric study of 11 representative points in the spectra of 26 G. K and M stars (giants and dwarfs) is made and it is found that I is stronger in dwarfs than giants; for G0–K5 stars; this quantity chiefly measures the intensity of the Mg triplet (3^3P°–4^3S). In the theoretical interpretation, he finds a disagreement with Russell [see Abstract 90 (1930)] in that the lines of neutral Ca and Mg are strengthened in dwarf spectra. A. S. D. M.

1096. Contours of Emission Lines from Expanding Gaseous Shells. T. Araki and M. Kurihara. *Zeits. f. Astrophysik,* 13. 2. *pp.* 89–103, 1937.—The formal theory of absorption and emission coefficients of spectrum lines is applied to the case of line-emission from the expanding gaseous envelopes which surround such objects as Wolf-Rayet stars, Novæ, and stars of the P Cygni type. The authors define as " effective μ-centres " points in the shell which emit radiation of frequency ν which is observed as radiation of frequency μ. Assuming that spherical symmetry exists in the shell, and that the streaming velocities are exclusively radial and are large compared with the velocity of turbulence but small compared with that of light, they use the coordinates of such effective centres to calculate the quantities needed to define the contour of the emission line ν. By integration over the locus of the effective centres, an expression is obtained for the emission contour. The effect of the internal velocity distribution on the general form of emission-line profiles is discussed for the case of a large spherical shell of gas. Practical comparisons are made with emission profiles in recent Novæ. A. Hu.

1097. Luminosity, Spectrum and Colour of B and A Stars. G. Shajn. *Zeits. f. Astrophysik,* 13. 2. *pp.* 132–148, 1937. *In English.*—By correlation of the colour excesses of O and B stars with the luminosity, spectrum and character of lines the following conclusions are arrived at: (1) Be stars appear to be only slightly brighter than Bn stars, (2) the hypothesis of constant luminosity of Bn stars is invalid, (3) Bs stars are somewhat brighter than Bn stars, (4) the dispersion of absolute magnitudes of Bs stars is probably not much larger than that of Bn stars. In the case of An stars considerable evidence points to invalidity of the hypothesis of constant luminosity. A large divergence in absolute magnitudes of An stars obtained by two different Mt. Wilson methods is traced in part to a systematic difference between Mt. Wilson and Harvard spectro-luminosity classifications and is reduced by reduction to the Harvard classification. The same reduction removes much of the luminosity difference between As and An stars. J. E. K.

1098. Polytropic Index and Photospheric Conditions. H. N. Russell. *Roy. Astron. Soc., M.N.* 96. *pp.* 127–132, *Dec.,* 1936.—A solution is given of the problem of determining the polytropic index n when it is known that, in a stellar model, the mass M inside radius r and the pressure and density at that distance from the centre are related by the formulæ for a polytrope of index n. It is also assumed that, at the level considered, the material of the star is a perfect gas of known molecular weight and temperature. For main sequence stars the analysis indicates a value of n between 2 and 4. G. C. McV.

1099. Occurrence of Negative Density-Gradients in Stars and Allied Problems. S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 97. *pp.* 132–149, *Dec.*, 1936.—The problem of finding a lower limit to the central radiation pressure for a given concentration of the energy sources towards the centre of a stellar model, above which an outward increase in density would result near the centre, is solved in certain cases. The energy generation is assumed to be proportional to a positive power of the temperature and, in an extension of the analysis, to the product of powers of the density and temperature. With the solution which is adopted as the standard case, it is found that if the central radiation pressure, $(1-\beta_c)$, is greater than ½ the negative density gradients will occur, but not otherwise. G. C. McV.

1100. Production of Energy in Stars. M. Schwarzschild. *Zeits. f. Astrophysik*, 13. 2. *pp.* 126–131, 1937.—The three observable stellar magnitudes, mass M, luminosity L and radius R, are connected by two equations, the mass/luminosity relation and the equation of energy transformation. On the basis of Eddington's stellar model, a determination by Stromgren that the luminosity depends essentially on mass and H content, and some rational minor simplifying assumptions, a solution of the latter equation is obtained which leads to the conclusion that, either some unknown energy-dissipating process, whose yield decreases with increasing density, takes place in the interior of a star, or there exists some factor influencing the production of energy which is determined uniquely by the mass and H content in such a manner that the energy production increases with increasing mass and decreasing H content. J. E. K.

1101. Constitution of White Dwarfs. E. Sevin. *Comptes Rendus*, 204. *pp.* 335–337, *Feb.* 1, 1937.—On the assumption that white dwarfs are composed internally of neutrons, the author finds that Eddington's mass-luminosity relation gives a fairly accurate value for the mass of the companion of Sirius. From the equation of radiative equilibrium, the central temperature of Sirius B is estimated at $4{\cdot}9 \times 10^8$ °C. If, however, as seems probable, the star is near the head of a " white dwarf sequence " characterised by a diffusion of internal energy due to the spin of the neutrons, other lines of approach put the value at between two-thirds and three-quarters of this figure. The author considers that white dwarfs form a stellar sequence analogous to the main sequence, the transition from one to the other being effected by a stellar cataclysm which may manifest itself as the outburst of a Nova. After cooling, their material will be of some solid " neutron " substance analogous to solid H_2 but of density 6×10^{15} times greater. A. Hu.

1102. Galactic Rotation of the Globular Cluster System. H. Mineur. *Roy. Astron. Soc., M.N.* 97. *pp.* 150–153, *Dec.*, 1936.—The author replies to criticisms of his theory of galactic rotation brought by F. K. Edmondson [see Abstract 3090 (1936).] G. C. McV.

1103. Two New Short-Period Spectrum Variables. D. L. Edwards. *Roy. Astron. Soc., M.N.* 97. *pp.* 99–104, *Dec.*, 1936.—Variations of line intensities have been studied in the two stars ι Herculis and ψ Eridani. In particular, the relative intensities of $\lambda\lambda$ 4388 and 4481 have been measured with a wedge, and the results show definite periodic variations in both stars. In the case of ι Her, the period is found to be $0^d{\cdot}1434$

with a steep rise to maximum intensity difference ($0^d{\cdot}04$) and a slower decline ($0^d{\cdot}10$). ψ Eridani shows a somewhat similar curve, and both stars appear definitely to belong to the class of short-period variables typified by β Canis Majoris. AUTHOR.

1104. Intensity Distribution in the Spectrum of Nova Lacertæ. A. Behr. *Zeits. f. Astrophysik*, **13**. **2**. *pp*. 108–112, 1937.—Examples of microphotometer curves from 5 spectrograms of the Nova obtained towards the end of June, 1936, are reproduced. The comparison stars are α Cephei and γ Cassiopeiæ. The spectra extend from Hα to beyond the H and K lines. The author points out the difficulty of deriving a " smooth continuum " from spectra showing such large intensity variations as these, and discusses methods of getting over the trouble. The relative intensity distribution between the Nova and the comparison stars is shown graphically for the various dates, and the gradient differences are derived. As with Nova Herculis, decreasing total luminosity is accompanied by an increase in colour temperature and by a sharper rise of the continuum in the violet region. A. Hu.

See also Abstract **1189**.

SUN.

1105. Solar Coronal Polarisation (Total Solar Eclipse of 31 August, 1932). J. Dufay and H. Grouiller. *J. de Physique et le Radium*, 7. *pp*. 481–496, *Dec*., 1936.—A table is given of qualitative observations in eclipses which are discordant, and the authors describe the methods used in the 1932 eclipse. From 3900–5700 Å the proportion of light polarised is nearly independent of wave-length ; near 0′·14–2′ from the line b ; it increases rapidly to 0·26 at 8′–10′, and then decreases more slowly from 25′ back to the value at 2′. This is confirmed by Lyot for prominences [see Abstract 574 (1937)]. Atmospheric diffused light in the corona is not negligible and the authors correct for this, Baume-Pluvinel and Barbier's observations. Since, also, the energy curve of the coronal continuous spectrum is identical with the sun's, they conclude that the continuous spectrum light comes from a neutral diffusion of solar light (free electrons). The proportion of polarised light is too weak for Minnaërts electronic theory, and this is confirmed by J. J. Johnson's visual measures in the 1934 eclipse. A. S. D. M.

***1106. Topoheliometer. M. Abe.** *Geophys. Mag., Tokyo*, 10. *pp*. 397–410, *Dec*., 1936. *In French*.—A special apparatus is described the object of which is to observe at any desired time and place, the times of rising and setting of the sun and the duration of insolation. The construction of the apparatus is described and the method of using it. The principle underlying it is shown to be the same as that of the astronomical telescope. Results obtained by its aid for each of the 12 months of the year are given in tabular form and shown also by diagram. A photograph of the instrument is reproduced. A. E. M. G.

See also Abstracts **1117**, **1124**, **1129**, **1133**, **1181**.

GEOPHYSICS.

GEODESY.

1107. International Bibliography of Geodesy, 1928–1930. G. Perrier and P. Tardi. *Bibliographie Géodésique Internat,* 1. [301 *pp.*]. 1935.

1108. Analogue of Stokes' Formula for the Prey and Bouguer Gravity Anomalies. W. D. Lambert. *Gerlands Beitr. z. Geophys.* 49. 1–2. *pp.* 199–209, 1937. *In English.*—A new proof is given of Malkin's method [see Abstract 4158 (1935)] of showing how Stokes' formula for determining the undulation of the geoid must be modified if Prey's or Bouguer's anomalies are used; special attention is paid to the physical dimensions of the quantities occurring and to the harmonic terms of degrees 0 and 1. This results in a slight modification of Malkin's formula. A similar formula is given for the Bouguer anomaly. The corrections necessary are, however, shown to be so large as to make the use of either anomaly undesirable for determining the figure of the earth. C. A. S.

GEOPHYSICS, APPLIED.

1109. Relative Gravity Determinations in the West German Coal Field. S. v. Thyssen. *Beitr. z. angew. Geophys.* 6. 3. *pp.* 319–331, 1937.—Gravity determinations with a Thyssen gravimeter [see Abstract 5056 (1936)] are compared with the geological structure in the neighbourhood of Recklinghausen, and Herzogenrath near Aachen. A definite connection between the gravity variations and the conformation (synclines and anticlines) of the coal deposits is demonstrated. As the difference in density of the coal, etc., and rocks is insufficient to account for this, the cause of the variations must be in the underlying Devonian rocks, which must be folded similarly to the carboniferous strata. The gravity determinations can therefore only disclose post-carboniferous movements. C. A. S.

See also Abstract 1309.

HYDROSPHERE, PHYSICS OF THE.

1110. Effect of Prevailing Winds upon the Depth of Bays. M. Nakano. *Geophys. Mag., Tokyo,* 10. *pp.* 359–395, *Dec.,* 1936. *In English.*—The transport of sand and mud on the bottom of shallow seas or bays due to the action of wind waves is considered. Equations are established for the velocity and range of motion of water particles due to wind waves and relations are established between the wave height, fetch distance, wind velocity and wave-length. Erosion, transportation and sedimentation depend mainly upon (1) size of the particle and (2) velocity of the water and only slightly upon shape and specific gravity of the particle. A graph shows the connection between (1) and (2) and erosion, transportation and sedimentation for uniform grain size. For mixed sizes a different relation holds. The effects of gravity, hydrodynamical upthrust and turbulence on these factors are discussed and the general equations connecting them are applied to the stationary state and with and without erosion. Finally the amount of material eroded or deposited is determined. [See Abstract 4595 (1936).] R. S. R.

1111. Propagation of a Wave Along a River. L. Cagniard. *Comptes Rendus*, 203. *pp.* 1324–1326, *Dec.* 14, 1936.—A simplified formula is derived for the propagation of a surface wave of feeble amplitude along a river. The down-stream wave has a quasi-permanent régime, but this is not so in the case of the up-stream wave. W. A. R.

LAND, PHYSICS OF THE.

1112. Convection Currents in Geysers. A. L. Hales. *Roy. Astron. Soc., M.N. Geophys. Supplement*, 4. *pp.* 122–131, *Jan.*, 1937.—It is shown mathematically that if a liquid is heated from the bottom in a cylindrical tube (radius a) viscosity prevents convection currents until a certain temperature gradient (β) is reached, or unless a is above a certain minimum, a and β being connected by the approximate relation $a^4\beta =$ constant. If $a^4\beta$ is $<$ this constant a geyser with pipe of radius a will erupt periodically provided β is sufficient for the temperature at some depth to be $>$ the boiling point at that depth; if $a^4\beta$ is $>$ the constant the geyser will be in a constant state of ebullition and not erupt. In a note **H. Jeffreys** adds the values of β for various values of a, and the corresponding depths at which the boiling point would be reached; but doubts the author's suggestion that eddy conduction and viscosity can have much effect in controlling geyers. C. A. S.

1113. Temperature Measurements in Oil Wells. M. Schlumberger, H. G. Doll and A. A. Perebinossoff. *Inst. Petroleum Technologists, J.* 23. *pp.* 1–20; *Disc.*, 20–25, *Jan.*, 1937.—Continuous temperature measurements in oil wells can now be made with an extremely sensitive recording thermometer. They can be applied to a great number of oil-field problems, both in wells in thermal equilibrium and in wells in thermal evolution, and also both in open and in cased holes. The data on geothermal gradients and their variations interest both the regional and local geologist. Knowledge of subsurface temperatures can aid the technologist in problems related to mud and cementing. Temperature measurements can yield valuable corroborative data on the sequence of formations in a well, the main data always preferably being given by electrical logging. They can be applied to location of water, oil- or gas-sands, both in drilling and in already tested or produced wells. They are invaluable for checking the results of a cementing operation. The paper presents the principles of the major thermometric techniques, and illustrates them with some practical examples. In conclusion, attention is drawn to the time and care that may sometimes be required for optimum results, but practice has already proven that the best local operating conditions are very soon determined in most regions, thanks to the spirit of co-operation existing between the surveyor and the local technologists. AUTHORS.

1114. Dispersion and Absorption of Elastic Waves in Rocks. P. T. Sokoloff and V. I. Skriabin. *Gerlands Beitr. z. Geophys.* 49. 1–2. *pp.* 165–198, 1937. *In English.*—Young's modulus, the modulus of rigidity, Poisson's ratio and the hysteresis constants with density, etc., for 20 varieties of rock were determined from some 300 specimens. In many cases the elastic after effect exceeded the true elastic deformation. The relations between these various quantities are discussed mathematically, as also the diffusion of elastic waves in the various rocks. Formulæ for the phase velocity and coefficient of absorption are deduced, which agree satisfactorily with experimental results. Lastly taking into consideration the hysteresis effects reflection and refraction of elastic waves are dealt with, showing that these, as also the amplitude of the reflected and refracted waves and phase variation, depend on the frequency. C. A. S.

1115. Specific Heat of Bound Water and of Soil. P. I. Andrianow. *Kolloid Zeits.* 78. *pp.* 107–108, *Jan.*, 1937.—The specific heat of the soil is considered in relation to the specific heats of its solid component and of the free and bound or hygroscopic water. Each of these is discussed briefly. The value for the solid portion is of the order of 0·2. It is shown, as the result of experiment, that the specific heat of the hygroscopic water has an average value of 0·70–0·75, and also that the value for the water of crystallisation of several salts ranges from 0·4–0·8. The importance of these soil properties is briefly mentioned, and an equation is deduced which gives the specific heat of 1 gm. of moist soil in terms of the total weight of the solid portion, the weight of the hygroscopic water, and the total weight of the water in the soil. E. H. D.

See also Abstracts 1089, 1090, 1091, 1139, 1140.

METEOROLOGY.

***1116. Radon Content of Air near the Ground. W. Kosmath.** *Phys. Zeits.* 38. *pp.* 82–83, *Feb.* 1, 1937.—A description of the apparatus used to take samples of the air is given. The air so obtained which is at a pressure of 4–5 atmos. is then tested for Rn content by being allowed to pass gradually into charcoal tubes. The adsorbed Rn is now driven out by heating and the amount determined. The process is described. To investigate the distribution of Rn vertically in the atmosphere several sampling vessels are necessary of about 50 l. each. This permits of samples being obtained at various heights each with sufficient Rn content.

A. E. M. G.

1117. Air Temperature during Total Solar Eclipse, June 19, 1936. J. L. Haughton. *Roy. Astron. Soc., M.N.* 97. *pp.* 96–99, *Dec.*, 1936.—The observations were carried out on board ship in Lat. N. 37°08′, Long. E. 23°30′. A description of the apparatus used, a multiple thermocouple, is given. The method of observation is outlined and the results achieved are discussed. The maximum fall as seen from a curve based on the observations, occurs just after totality and amounts to 1·5° C. A comparison is made with observations taken during the total eclipses of 1927 and 1932. A. E. M. G.

1118. General Circulation of the Atmosphere. S. Sakuraba. *Geophys. Mag., Tokyo,* 10. *pp.* 331–344, *Dec.*, 1936. *In English.*—A. Overbeck's theory of the general circulation of the atmosphere is improved by taking into account the centrifugal force due to the earth's rotation. The result of the calculations shows that in middle latitudes the centrifugal force operates to oppose Oberbeck's currents, and in higher latitudes to support them. The exact estimation of the effects is, however, a difficult task. AUTHOR.

1119. Application of Wet-Bulb Potential Temperature to Air Mass Analysis. Part II. E. W. Hewson. *Roy. Meteorolog. Soc., J.* 63. *pp.* 7–28; *Disc.*, 29–30, *Jan.*, 1937.—In this paper, the horizontal component of the motion of air in a depression has been traced approximately by means of upper wind and high cloud observations, and by the pressure distribution at 2 km. and 5 km., and the vertical component found by the use of wet-bulb potential temperatures. The trajectories found in this way show clearly that there is considerable horizontal divergence in the warm air ascending at the warm front of a depression. A study has also been made of the changes which occurred in the humidity mixing ratio x. [For Part I see Abstract 3562 (1936).] AUTHOR.

1120. Logarithmic Law of Wind Structure near the Ground. O. G. Sutton. *Roy. Meteorolog. Soc., J.* 63. *pp.* 105–107, *Jan.,* 1937. The author replies to a criticism that the logarithmic law $u_z/u_1 = \log(1 + az/z_1)/\log(a + 1)$ holds only in adiabatic changes by showing that it holds also in conditions which are not adiabatic. Velocity profiles for both unstable and stable conditions are examined and the latter case particularly shows no systematic departure from the logarithmic law towards a power law. It is to be concluded therefore that the law is valid for all conditions and that the variation in a is real and may be regarded as a measure of the turbulence present. It is further shown that the "roughness length," or z_0, is, in the expression, the height at which the velocity is zero. In the adiabatic case it modifies the profile due to surface roughness. Similar formulæ for other cases enable an interpretation to be given of the variation of a with temperature gradient. A. E. M. G.

1121. Changes of Mean Wind Movement over Long Periods. F. Travniček. *Naturwiss.* 25. *pp.* 23–24, *Jan.* 8, 1937.—In a diagram is shown the yearly frequency of days with storms at Sonnblick (3106 m.), Obir (2044 m.) and Vienna (203 m.). The curves show for each station a period of about 30 yr. for storm frequency with the amplitude at the maximum about double that at the mimimum. A 4 yr. period is also shown. The phase of the wave at Vienna is however opposite to that at the two higher levels and at about 1–1½ km. the amplitude must be zero. The wave is supposed to be due to internal changes in the atmosphere caused by varying amounts of vorticity. Hamburg and Kiel show a similar change in wind speed. The next maximum at low levels falls in 1940. The effects of this variation on climatic changes is considered. R. S. R.

1122. Wind Conditions of the Arlberg. Part II. Aerological Observations. E. Ekhart. *Gerlands Beitr. z. Geophys.* 49. 1–2. *pp.* 7–25, 1937.—The existence of the Maloja wind or overlapping valley breeze has been confirmed by simultaneous series of pilot balloon ascents during several days at the three stations and by observation of certain typical cloud formations similar to the Maloja serpent. The "Kloster" valley wind is, however, still effective temporarily and cases are given showing the retardation in the time of the diurnal change of this wind from west to east. The horizontal temperature gradient between the inclined base of the valley and the free atmosphere furnishes the energy necessary to create an anabatic wind and in this way too the valley wind can enter even steep V-shaped valleys. Two possibilities are considered to explain the overlapping valley breeze of the Arlberg, a phenomenon of a movement of inertia or a genuine overlapping valley breeze. The thermal effects of the diurnal change of local winds are shown by measurements on the ground. [See Abstract 5481 (1936)]. R. S. R.

1123. Atmospheric Oscillations. C. L. Pekeris. *Roy. Soc., Proc.* 158*A*. *pp.* 650–671, *Feb.* 3, 1937.—Brief references are first made to previous work on this problem. The author approaches the problem by determining first the forced tidal oscillations of a horizontally uniform atmosphere on a rotating globe. This method is then applied to an atmosphere in which a temperature distribution above 60 km. can be found such that the atmosphere will have a free oscillation of period close to 12 hrs. provided the temperature increases between 30 and 60 km. in the manner indicated by the anomalous dispersion of sound waves. In this oscillation a horizontal nodal surface exists at about 30 km. at which velocities and pressure variations vanish. At 100 km. the amplitude of the velocities are about 200 times larger than at the surface. Further, it is found that this atmosphere has another mode of free oscillation with 10½ hr. period and no nodal surfaces. It is further pointed out that the existence of a semi-diurnal free oscillation restricts to a certain extent the possible temperature distribution in the upper atmosphere. A. E. M. G.

1124. Influence of Sunspot Period on Precipitation and Yearly Growth Rings of Trees. A. Bečvář. *Gerlands Beitr. z. Geophys.* 49. 1–2. *pp.* 1–6, 1937. *English Abstract.*—The material of measurements of the year rings of old trees as they were published by A. E. Douglas for 14 different places, shows distinctly the existence of the double sunspot period (Hale's period) in three characteristic types B, C and BC, as they were differentiated in S. Hanzlík's paper [see Abstract 2639 (1936)]. It is possible, by means of such measurements, to ascertain the effect of the sunspots on the precipitation in different countries without knowledge of the direct precipitation measurements from these places. AUTHOR.

1125. Droplet Size in Mists. N. Fuchs. *Phys. Zeits. d. Sowjetunion,* 10. 3. *pp.* 421–423, 1936. *In German.*—The water droplets are caught on a mixture of vaseline and mineral oil, whereby they are covered with a very thin film which greatly reduces their rate of evaporation and makes it possible to measure their size directly. L. A. W.

1126. Evaporation of Raindrops. Y. Takahasi. *Geophys. Mag., Tokyo,* 10. *pp.* 321–330, *Dec.,* 1936. *In English.*—The experimental method of observing the evaporation of the drops in a wind channel is outlined and an evaporation formula derived. The air velocity is then taken as the velocity of the falling drop. The evaporation formula is now integrated and two methods are outlined whereby the amount of evaporation may be calculated, the first, graphical, suitable for small drops, the other for larger drops. The disappearance of raindrops on the way to the ground is also discussed. In the concluding section where the increase in the humidity of the air by evaporation of raindrops is investigated, the author finds that for a given amount of precipitation the smaller the raindrops the quicker the humidity rises. The paper is illustrated by a number of diagrams. A. E. M. G.

1127. Formation of Coloured Rain. C. J. Boyden. *Roy. Meteorolog. Soc., J.* 63. *pp.* 47–53, *Jan.,* 1937.—An examination is made of the meteorological conditions leading up to a thunderstorm which gave heavy falls of coloured rain in Shetland on March 16, 1935. Evidence is given that the instability was caused in an air mass which was initially very stable, by forced ascent through the undercutting by denser air. The rare combination of conditions described is consistent with the scarcity of coloured rain in this country. The hypothesis put forward for the particular case of the Shetland thunderstorm is suggested as applicable to the more common "red rain" originating in desert areas. AUTHOR.

1128. Snow Structure : Practical Applications. G. Seligman. *Roy. Meteorolog. Soc., J.* 63. *pp.* 93–103, *Jan.,* 1937.—After referring to the way in which snow is formed and to the many forms of simple snowflakes, the author discusses how it comes about that they assume their characteristic forms. The distribution of both simple and complex snowflakes in storms is also considered. Turning then to snow after it has fallen the author deals with it as it passes stage by stage to glacier ice through the process of firnification. The effect of wind is also referred to. Avalanches, their causes and forms, are next dealt with. They are classified into three main groups, dry, wet and wind-slab. Each is discussed in turn. From the investigation it can be seen that a knowledge of the wind structure and the past weather conditions over a district are of the greatest importance to mountaineers. The paper is illustrated by a large number of excellent photographs. A. E. M. G.

1129. Variation of Pressure Anomalies Compared with Solar Activity. L. Petitjean. *Comptes Rendus*, 204. *pp.* 141–143, *Jan.* 11, 1937.—Records show that during the period 1889–92 polar air was more active than tropical when the number of sunspots was decreasing rapidly or increasing slowly, the reverse when sunspots were increasing rapidly or diminishing slowly. (No figures or curves are given). C. A. S.

1130. World Weather. Part VI. G. T. Walker and E. W. Bliss. *Roy. Meteorolog. Soc., Mem.* 4. *pp.* 119–138; *Disc.*, 139, *Jan.*, 1937.—The fluctuations of pressure, temperature, and rainfall in winter in the region of the North Atlantic had been studied as a connected system in the last paper of this series [see Abstract 534 (1933)]; and a similar system is now shown to hold in the spring, summer and autumn. But the amount of persistence is small, so that the results are of little value for foreshadowing weather; nor does a consideration of the trade wind region lead to success in this respect. Similarly the Southern Oscillation which was found active in the summer and winter seasons over a large part of the globe is now shown to function in the two remaining seasons; and while that of March to May has little control over the following quarter, the Southern Oscillation of Sept. to Nov. has a correlation coefficient of 0·90 with the Oscillation of Dec. to Feb. Thus there are a number of relationships of between 0·60 and 0·82 available for foreshadowing weather. AUTHORS.

1131. Visibility Observations. R. M. Poulter. *Roy. Meteorolog. Soc., J.* 63. *pp.* 31–45; *Disc.*, 45–46, *Jan.*, 1937.—The range of distance embraced by a visibility number used at meteorological stations varies roughly as the lower limit of the range, so that one occasion in a year of visibility 3 (500 m.,–1 km.) is twenty times as significant as one occasion of visibility 7 (10–20 km.), and so on. Accordingly, frequency curves characteristic of six types of meteorological stations in the British Isles, judged by the surrounding country, have been drawn by plotting the number of occasions per km. (n/d) covered by each visibility number. The 54 curves refer to 7 h., 13 h., and 18 h. for summer, winter, and the year for stations grouped in the following categories: (*a*) Coastal (clean air; clean air with sea fogs; polluted air). (*b*) Inland (clean air; polluted air, rural; polluted air, urban); and show marked seasonal and diurnal variations. AUTHOR.

1132. Colour of the Night Sky. R. Grandmontagne. *Comptes Rendus*, 204. *pp.* 337–340, *Feb.* 1, 1937.—A self-registering photoelectric photometer is used to compare the intensity distribution in the spectrum of the night sky with that of a tungsten lamp run at a colour temperature of 2113°K. Dispersion is effected by screening the photoelectric cell with blue, green and red filters of known transmissivity, passing radiation of effective wave-lengths 4250, 5475, and 7325 Å. respectively. The distribution found for the night sky is not that of a black body, but the colour temperature of the nearest equivalent black body is 2280° K., a value very much lower than previous estimates. The suggestion that this high luminosity in the red may be due to the light of the extra-galactic nebulæ is examined, but the presence of emission bands in the red and near infra-red is put forward as the more likely cause. A. Hu.

1133. Estimation of Atmospheric Humidity from Solar Intensities. F. Herzing. *Gerlands Beitr. z. Geophys.* 49. 1–2. *pp.* 71–96, 1937.—A simple, easily-portable quartz double monochromator with a thermopile and galvanometer gives a quick method of estimating the intensity of the sun's spectrum, in the infra-red particularly. By correlating the results of balloon measurements of the water vapour in the atmosphere with the depth of the corresponding absorption bands of the solar spectrum, a relation between the depths of the bands and the water vapour content is found and the spectrometer can be used to give an exactness of the latter to 4 % for a recording time of 1–2 min. Also the relation between the water vapour content and the precipitation is confirmed at the Taunus Observatory and found to deviate from Hann's formula $\mathrm{w}_e = ke_e$. H. M. B.

See also Abstracts 1106, 1157.

SEISMOLOGY.

1134. Polarisation of Elastic Waves Generated from a Plane Source. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 489–505, *Dec.*, 1936. *In English.*—With a view to seismological problems the following cases are worked out: (*a*) plane source with changing normal stress; (*b*) plane source with changing shearing stress; (c) plane source generating dilational waves of the same phase along the source. W. A. R.

1135. Distribution of Displacements in a Seismic Wave Front. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 506–513, *Dec.*, 1936. *In English.*—The distribution of the displacements in a wave front at different radial distances is affected by the nature of the medium through which the waves are transmitted. The paper treats of the radiation of pure distortional waves from a spherical origin in grounds of different rigidity. W. A. R.

1136. Seismic Vibrations in Buildings. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 514–524, *Dec.*, 1936. *In English.*—The authors' theory [see Abstract 5485 (1936)] is now applied to the dissipitation of the energy of seismic vibrations in an eight-storied structure. W. A. R.

1137. Seismic Vibrations of a Pagoda. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 525–533, *Dec.*, 1936. *In English.*—A five-storied Japanese pagoda is earthquake proof. It appears that the resistance of the tower is due to the smallness of its effective height and to the marked dissipation of vibrational energy in the form of elastic waves. The *sinbasira*, a kind of central post within the tower, does not help, and may act so as to increase the seismic vibrations. W. A. R.

1138. P′ Waves and Analogous Phenomena in Optics. M. Morita. *Geophys. Mag., Tokyo,* 10. *pp.* 345–357, *Dec.*, 1936. *In English.*—From 53 records obtained in Japan of the S. American earthquake of Dec. 14, 1935 (at 72·5–73·5° W, 5·5–6·5° S) the focus of the P′ waves of which falls in the main island of Japan, a time-distance curve of the initial phase was deduced, and also M-Δ curves (M being the maximum amplitude) for Δ = 135°–150°. It is suggested that the results are explicable (on the analogy of light) by diffraction and interference of the

P'_1 and P'_2 waves as a result of their passing through the earth's core, and (on the analogy of the rainbow) by refraction and reflection through, or from the surface of the core. Quantitative support to this view is to be given later. C. A. S.

1139. Structure of the Earth down to the 20° Discontinuity. Part II. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement,* **4.** *pp.* **13–39,** *Jan.,* **1937.**—The observations used by Gutenberg and Richter as evidence against the discontinuity in $dt/d\Delta$ for P at about 20° agree better with the author's times and their mean apparent velocities show such a distribution as would be expected if those times were correct. The observations of Sd in two deep-focus earthquakes have been found to agree well with prediction, using the solution already found. Eight normal and four deep earthquake shocks were used to find a new set of travel times for S and SKS, which appear trustworthy to about 2 sec. but some corrections for minor systematic errors still need to be made. Up to about 40° they agree fairly well with the times of Gutenberg and Richter on the assumption that the latter refer to surface focus, but Gutenberg and Richter's 1935 times appear to be about 11 sec. too short at 80° to agree with this hypothesis. It appears that the author's previous times for S and SKS are fairly good up to 70° but that at greater distances they are too long. [For Part I see Abstract 3127 (1936).] R. S. R.

1140. Surface Waves Associated with the 20° Discontinuity. R. Stoneley. *Roy. Astron. Soc., M.N., Geophys. Supplement,* **4.** *pp.* **39–43,** *Jan.,* **1937.**—Reference is made first to the results obtained by Jeffreys and others relating to the 20° discontinuity [see preceding Abstract]. Treating this upper layer as a surface one, surface waves of the Love type and of very long wave-length should be propagated, if suitably excited, and Rayleigh waves of long period should be modified in much the same way as the waves of moderate periods are altered by the presence of the surface layers. Values of the constants used are stated and calculations are made for the two types of waves to provide a search ephemeris rather than a very accurate table of values of the wave velocity and group velocity for different periods. The conditions for observing the waves are discussed. R. S. R.

1141. Deep-Focus Earthquakes. B. Gutenberg and C. F. Richter. *Seismological Soc. of America, Bull.* **26.** *pp.* **340–390,** *Oct.,* **1936.**—Travel times of normal earthquakes are made the basis for calculated travel times for shocks at depths down to 800 km. These are presented in tabular form, together with certain auxiliary data. Theoretical discussion is given for the critical distances at which pP and PP, sP and SP, etc., coincide, and below which these phases should not occur. These distances are not focal points (caustics). Methods are given for determining epicentre, depth, and origin time, and are applied to a selected group of shocks. The results of different methods agree very well with one another and with the calculated travel-time data. A preliminary report is given on certain characteristics of the shocks studied. The mechanism of deep-focus earthquakes is discussed briefly, and it is concluded that normal and deep-focus earthquakes are probably brought about by the same forces. [See Abstract 3570 (1936).] AUTHORS.

***1142. Shaking-Table Investigation of Teleseismic Seismometers. H. E. McComb and F. Wenner.** *Seismological Soc. of America, Bull.* **26.** *pp.* **291–316,** *Oct.,* **1936.**—Four seismometers—Wood-Anderson torsion (1), Wilip-Galitzin (2), Wenner (3) and McComb-Romberg

(4)—and the shaking table are figured and described, as also the methods of producing harmonic or irregular movements of the last named. Several records as given by the seismometers are reproduced and discussed, showing that the records of 1, 3 and 4 are very similar under similar conditions; and that it is not possible to determine the direction of the initial ground movement even where there is a sharp impulse, or the direction or magnitude of the maximum displacement, or of the dominant periods of a P or S phase. [See following Abstract.] C. A. S.

***1143. Galitzin Seismometer. F. Wenner and H. E. McComb.** *Seismological Soc. of America, Bull.* 26. *pp.* 317–322, *Oct.*, 1936.—In consequence of the unsatisfactory behaviour of the Wilip-Galitzin seismometer on the shaking table [see preceding Abstract] its movements were compared with the theoretical. Departure from what was to be expected was found to be due (1) to failure of the instrument to comply with the Galitzin theory that the reaction of the motion of the galvanometer coil on that of the steady mass is negligible, and (2) to defective construction due to presence of magnetic material somewhere within the field of the damping magnets. C. A. S.

See also Abstracts 1047, 1114.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1144. Investigation of Lightning Discharge with the Magnetograph. H. Hatakeyama. *Geophys. Mag., Tokyo,* 10. *pp.* 309–319, *Dec.,* 1936. *In English.*—The sudden change of magnetic field strength at the instant of a lightning discharge was obtained from the highly sensitive quick-running magnetograph. During the remarkable thunderstorm of Aug. 26, 1934, at Toyohara 46 cases were found from the horizontal force magnetogram and the electric quantity was calculated for the lightning discharge. The quantity ranged from 20–30 to 200–300 coulombs, much larger values than those found by Wilson and Schonland. The cloud had a polarity of Wilson's type. R. S. R.

1145. Field of Diurnal Variation of Terrestrial Magnetism. M. Hasegawa. *Imp. Acad. Tokyo, Proc.* 12. *pp.* 277–280, *Nov.*, 1936. *In English.*—A brief description of how the field of diurnal magnetic variations progressed round the earth on the days of Sept. 23, 24, 1933, and June 21, 23, 1934 [see Abstracts 5076 (1936) and 598 (1937)]. The centres of potential corresponding to the different hours of the two September days are plotted on a world map. These centres do not keep their positions on latitude circles during their revolution round the earth, but describe a path of wave-like form. The opinion is expressed that even if the phenomenon take place all round the earth, it is not independent of terrestrial inequalities. G. E. A.

1146. Sources of Error in Measuring Earth Currents with Short Circuits. G. Arnold. *Gerlands Beitr. z. Geophys.* 49. 1–2. *pp.* 140–164, 1937.—Apart from artificial sources of disturbance due to electric trams, electrically worked instruments, etc., the variable currents from which prevent the finding of any fixed equipotential lines, contact and polarisation phenomena at the electrode-earth contacts (various forms of contact were examined) are such as to mask any earth current that should be observable between two places a short distance (≯ 100 m.) apart. C. A. S.

See also Abstract 1159.

RADIOACTIVITY.

1147. Radioactive Isotope of Potassium. W. R. Smythe and A. Hemmendinger. *Phys. Rev.* **51.** ***pp.*** **178–182,** ***Feb.*** **1, 1937.**—By means of a high intensity mass-spectrometer the three isotopes of K are separated. Measurements of the radioactivity of the isotopic samples indicate that K^{40} is radioactive. Comparison of the β-particle emission from the isotopic samples and from KCl shows that K^{40} is responsible for both of the known β-ray bands. AUTHORS.

1148. Theory of α-Disintegration. L. Goldstein, *J. de Physique et le Radium,* **7.** ***pp.*** **527–532,** ***Dec.,*** **1936.**—The problem of the passage of an α-particle through a potential barrier is treated with the assumption that the α-particle is a rigid sphere of finite extension. The resulting formula for the decay constant is only slightly different from the usual formula in which the extension of the α-particle is neglected. R. P.

1149. Magnetic α-Spectra of Actinium Family. S. Rosenblum. M. Guillot and Marguerite Perey. *Comptes Rendus,* **204.** ***pp.*** **175–177,** ***Jan.*** **18, 1937.**—The α magnetic spectra of RaAc and AcX were measured with an improved arrangement [see Abstract 2662 (1936)]. Of RaAc four new lines were found, and three (α_4, α_5 and α_8) shown to be double; of AcX nine new lines (one doubtful). The energy intervals agree satisfactorily with the corresponding γ energies. Several apparent regularities in the intervals are pointed out. C. A. S.

1150. Equidistant Energy Levels in Nuclei of Radioactive Substances. S. Rosenblum and M. Guillot. *Comptes Rendus,* **204.** ***pp.*** **345–346,** ***Feb.*** **1, 1937.**—The repeated occurrence of multiples (or a sub-multiple) of 164 and 145 in the numbers of ekV in the energy differences of the lines in the magnetic α-spectrum, and in the energies of the corresponding γ-rays in the transformations ThC → ThC′, ThC″ → ThPb, and ThB → ThC is pointed out as possibly implying regularities in nuclear levels. C. A. S.

1151. Collision of a Slow α-Particle with Lithium. J. W. Frame. *Cambridge Phil. Soc., Proc.* **33.** ***pp.*** **115–121,** ***Jan.,*** **1937.**—In calculating approximately the probability of excitation of a Li atom by a slow α-particle, for an electron initially in the ground state which is excited to the $2p$ states, the α-particle is treated as a moving centre of force. An approximate form for the wave function of an electron in the field of an atom is obtained by the method of the variation of parameters. Simple expressions for the wave functions, χ_{10} and χ_{11} for the excited states are used. By numerical integration values of the probability P are obtained, for varying values of the impact parameter and of the velocity of the α-particle. Finally, P is integrated over all values of the impact parameter and thus the total cross-section for excitation is obtained, as a function of the velocity of the α-particle. A comparison is made with the results obtained by Born's method of approximation. G. O. B.

1152. Loss of Energy by α-Particles in Hydrogen. K. C. Kar and K. K. Mukherjee. *Phil. Mag.* **23.** ***pp.*** **230–239,** ***Feb.,*** **1937.**—Previous calculations on the subject are criticised on the grounds that they

are partly based on arguments taken from classical mechanics. A wave-mechanical formula is then derived, using perturbation theory. The applicability of this perturbation theory is not discussed. The formula contains an integral with respect to the distance between the colliding α-particle and the centre of the atom, and for the lower limit of this integration the authors insert the impact parameter as derived from classical mechanics. The results are not compared with experimental values.
R. P.

1153. β- and γ-Radiation of RaC″. S. Devons and G. J. Neary. *Cambridge Phil. Soc., Proc.* 33. *pp.* 154–163, *Jan.*, 1937.—Absorption experiments are carried out on the β- and γ-rays of RaC″. The range of the β-rays in Al corresponds to an energy limit of $(1 \cdot 95 \pm 0 \cdot 15) \times 10^6$ eV.; the absorption coefficient of the γ-rays in Cu corresponds to a fairly homogeneous radiation of quantum energy equal to $(5 \pm 1) \times 10^6$ eV. The energy of disintegration is, within the limits of error, in agreement with the value $6 \cdot 1 \times 10^6$ eV to be expected from the known energies of the other disintegrations in the RaC branches. AUTHORS.

1154. Structure of a β-Ray Line by Semicircular Magnetic Focusing. K. T. Li. *Cambridge Phil. Soc., Proc.* 33. *pp.* 164–178, *Jan.*, 1937.—The actual distribution of a homogeneous group of electrons by semicircular magnetic focusing is calculated for different types of source. The dependence of maximum intensity on the radius of curvature of the path of electrons is investigated and the approximate power laws assigned to different cases. The results can be used in the measurement of the intensity of β-ray line spectra. Tables of numerical values of effective solid angle subtended by the photographic plate at the source are given for some special cases. The results of the calculations are verified experimentally. AUTHOR.

1155. Absolute Intensities of the Strong β-Ray Lines of Ra (B + C), Th (B + C), and Ac (B + C). K. T. Li. *Roy. Soc., Proc.* 158*A*. *pp.* 571–580, *Feb.* 3, 1937.—The intensities of the strong β-ray lines of Ra (B + C), Th (B + C), and Ac (B + C) have been measured by the photographic method on the basis of equal numbers of disintegrating atoms. The results of the measurements confirm some values of Ellis and Aston for the three RaB lines and also Gurney's value for the ratio of the H line of RaB to the F line of ThB. By comparing the relative intensities of the strong lines in ThB and AcC the absolute intensities of all the β-ray lines of Ac(B + C) were obtained. Using the values of the internal conversion coefficients from the empirical curves of Hulme, Mott, Oppenheimer, and Taylor, the γ-ray intensities from Ac(B + C) could be calculated. For the strong γ-ray line from AcC it is possible to obtain values for the internal conversion coefficient by making use of the measured intensity of the α-ray groups. The value obtained is more than twice the theoretical quadripole curve and lies on the empirical curve referred to above. AUTHOR.

***1156. Theory of Electrostatic β-Particle Energy Spectrograph. F. T. Rogers, Jr.** *Rev. Sci. Instruments*, 8. *pp.* 22–24, *Jan.*, 1937.—The necessary equations are derived for the use of the electrostatic velocity analyser as an energy spectrograph for β-particles. A table is presented in which the conversion factor for converting particle-counts as a function of the electric deflecting potential to particle-counts as a function of energy is shown for electron energies of less than 10^5 eV. At low energies the conversion factor does not cause the excessive distortion of the observed curve that the conversion factor for the magnetic spectrograph causes in the same low energy region. It is thus concluded that the electrostatic analyser is suitable for the investigation of the lower reaches of the continuous β-particle spectrum. AUTHOR.

***1157. Radioactivity of Mountain Air. H. Garrigue.** *Ann. de Physique*, **6.** *pp.* **751–825,** *Dec.*, **1936.**—A detailed account is given of the apparatus used (both stationary and portable) and the methods followed in the investigations the results of which have already been published [see Abstract 1552 (1935)]. Rn determinations at other places in the Pyrenees (Canigou, etc.) make it probable that accumulation of Rn under snow is general. C. A. S.

***1158. Wilson Chamber for Projection Purposes. G. Herzog.** *Helv. Phys. Acta*, **10. 1.** *pp.* **68–71, 1937.** *In German.*—A detailed description is given of a Wilson chamber which can be employed to project α-tracks from a Po source on to a screen for demonstration purposes. The expansion takes place in a radial direction by the use of rubber tubes. G. O. B.

1159. Conductivity of Air in Potash Mine in Catalonia. C. Dauzère. *Comptes Rendus*, **204.** *pp.* **38–39,** *Jan.* **4, 1937.**—Determination of the conductivity of the air at various points in the potash mine at Sallent (N.W. of Barcelona), showed that in immediate proximity to beds of sylvite or carnellite it was scarcely 10% of that in the open, and that this latter was also greater than near spoil heaps containing 1 or 3 % K In immediate proximity of heaps containing 32 and 80 % KCl conductivity was respectively 5·07 and 11·19 compared with 2·30 in open air at the same time. These facts lend little support to the view that K is responsible for the increased ionisation in the neighbourhood of granite containing only 2–6 % K. C. A. S.

See also Abstracts 963, 967, 973, 974, 1008, 1009, 1116, 1330.

RADIATION.

ABSORPTION AND TRANSMISSION.

1160. Infra-Red Absorption in Supraconductors. J. G. Daunt, T. C. Keeley and K. Mendelssohn. *Phil. Mag.* 23. *pp.* 264–271, *Feb.*, 1937.—The absorption of infra-red radiation by Pb and Sn in the normal and supraconducting states was measured by the relative rates of evaporation of liquid He due to energy absorbed by the specimen, using an isothermal calorimeter with liquid He to produce the low temperature required for supraconductivity. In neither case was any appreciable change of absorption observed. This indicates that the energy exchange between electrons accelerated by a light wave and the crystal lattice is approximately the same in the two states. Possible explanations are discussed. N. M. B.

1161. Effect of Irradiation on the Transmission of Lithium Fluoride. E. G. Schneider. *J.O.S.A.* 27. *pp.* 72–74, *Feb.*, 1937.—The transmission of LiF in the visible and ultra-violet may be considerably reduced by exposure to very intense u.v. radiation, electron bombardment or contact with a low pressure electrical discharge. Strong absorption bands with maxima at 5200, 3100, and 2500 Å and a gradually increasing absorption below 1800 Å appear after a few min. exposure to electron bombardment or contact with the low pressure discharge. Since 75 hr. exposure to the light of a H-discharge tube caused only about a maximum decrease of 5 % in transmission, LiF may be considered as satisfactory as fluorite for use in u.v. optical instruments. Since all of the absorption bands build up at about the same rate, the visible discoloration, faint yellow to deep red, may be used as an indication of the change in the u.v. LiF coloured by irradiation may be useful as an u.v. filter. AUTHOR.

See also Abstract 1200.

COLORIMETRY.

1162. Colorimetry with a Spectrometer. R. A. Houstoun and A. J. Younger. *Phil. Mag.* 23. *pp.* 49–63, *Jan.*, 1937.—Continuing previous papers [see Abstracts 147 and 2837 (1934) and 2963 (1935)] the authors describe a modified form of spectrometer with Iceland spar prism which can be used for colorimetry on the hue and saturation basis. The hue is adjusted by moving the telescope of the spectrometer while the saturation is altered by rotating a nicol prism in front of the eyepiece. Some results obtained with the instrument are described in the paper and differences due to differences in the colour vision of the two observers (the authors) are sometimes quite large. The paper contains a table of the x, z coefficients for various colour temperatures on the Planckian locus and a number of observations on the variability of the colour of daylight at Glasgow. J. W. T. W.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

1163. Theory of Phosphorescence. D. Blochinzew. *Phys. Zeits. d. Sowjetunion,* 10. 3. *pp.* 424–426, 1936. *In German.*—In a previous publication [see Abstract 2844 (1934)] the author considers phosphorescence as due to the recombination of an electron and a " hole " localised in separate points of the crystal lattice. The present note is concerned with the process whereby the electron is freed from its localised state. An approximate calculation gives a result of reasonable order of magnitude for the rate of recombination. L. A. W.

1164. Phosphorescent Glass. Influence of Crystallisation. M. Curie. *Comptes Rendus,* 204. *pp.* 352–353, *Feb.* 1, 1937.—A description is given of the fluorescence, phosphorescence, and thermoluminescence of specimens of glass, and the effect on the duration and intensity of these phenomena after crystallisation has been induced by heating for long periods at 800–1200°. The specimens are ordinary glass and a zinc borate glass with the separate addition of 1 % Mn, Pb, Bi, Sm, and U. The mechanism and explanations of the observed results are discussed. N. M. B.

1165. Luminescence of Minerals. S. Kreutz. *Acad. Polonaise Sci. et Lettres, Bull. No.* 8–9*A. pp.* 501–509, *Oct.–Nov.,* 1936. *In German.*—Both Willemite from the Franklin furnace and the violet fluorite from the Boltsbury mine show strong fluorescence which disappears at temperatures of 480° and 210° to 230° respectively, reappearing with cooling. The colour of the violet fluorite can be expelled by strong heating without affecting permanently the fluorescence showing that the colouring centres have little to do with the fluorescence. Calcites show rather different heat properties. After strong heating they lose their luminescent properties for a time and then recover at varying rates. The recovery appears to begin with a few grains and gradually spreads throughout the whole mass in time (a few hours to a few days). The regenerated luminescence has a different colour from the original luminescence. Observations on the temperature variation of the luminescence of a number of calcites of various origins are given. Some observations on the luminescence of petroleums of various origins are also given. J. E.

***1166. Fluorometer. L. Brüninghaus.** *Comptes Rendus,* 204. *pp.* 118–120, *Jan.* 11, 1937.—The Gaviola fluorometer has two disadvantages: (1) the optical field of the Kerr cell is very limited and (2) the electro-birefringent liquid (nitrobenzene) is the source of disturbing diffusion which is prejudicial to precise measurements, due to the presence of numerous little gas bubbles on the liquid surface. In the new cell quartz piezoelectric systems replace the Kerr cells. Apart from this and a few minor modifications of less importance the operation is analogous with Gaviola's instrument without its disadvantages. The birefringent surface is much larger and the optical field is entirely free from diffusion effects. C. J. B. C.

See also Abstracts 1190, 1191, 1192.

INTERFERENCE, DIFFRACTION AND SCATTERING.

See Abstracts 1043, 1306, 1307, 1310.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

1167. Oxidation by Light of Tetraphenylnaphthazene. W. Koblitz and H. J. Schumacher. *Zeits. f. phys. Chem.* 35. *Abt.B.* 1. *pp.* 11–24, 1937.—The photo-oxidation of $C_{42}H_{28}$ in solutions of pyridine and benzene is investigated. The method adopted permits reproducible results to be obtained. It is shown that neither activated O_2 nor the long $C_{42}H_{25}$ molecule explains the oxidation. J. K.

1168. Silver Liberation in Photographic Emulsions. J. J. Trillat and R. Merigoux. *J. de Physique et le Radium*, 7. *pp.* 497–502, *Dec.*, 1936.—Gives the results of an examination of the electron diffraction produced by very thin emulsion films, the electrons producing at the same time chemical action in the liberation of Ag and physical action in the interference of the electronic waves. The rapid appearance of crystalline Ag liberated by the passage of electrons is viewed by means of a fluorescent screen. Certain regions of the thin films, however, only give rise to the AgBr diagram, the Ag diagram never appearing even after a very long electronic bombardment. Finally, the theories of the formation of Ag in photographic emlusions are considered in the light of the present results, the appearance of crystalline Ag, liberated by electrons, depending on the perfection of the crystalline state of the photo-sensitive salt, and being most easily formed when the crystalline state is not very perfect. Generally, the results are in agreement with the germ theory suggested by Sheppard. R. C. F.

1169. Nucleus- and Grain-Isolation in Photographic Materials. Lüppo-Cramer. *Kolloid Zeits.* 78. *pp.* 100–104, *Jan.*, 1937.—The term "nucleus-isolation" has previously been introduced to describe the effect of bathing exposed plates, before development, in acid solutions, particularly if they also contain certain dyestuffs or such developing substances as metol; such treatment markedly reduces the subsequently developed densities and this is attributed to protection or "isolation" of the exposure-nuclei by locally adsorbed dye, metol, etc. The effect is enhanced by increased acidity of the bath and by ageing of the solutions (oxidation or hydrolysis of the metol). In addition to examples of the foregoing, attention is drawn to the peculiar behaviour of the dyes capriblue and methylene blue in not only suppressing the original latent image but in giving rise to uniform heavy fog on subsequent development. This is ascribed to direct dyeing of the silver bromide grains and the removal of the protective-colloid action of the neighbouring gelatin; it is called "grain-isolation." L. V. C.

1170. Change of Sensitivity and Latent Image of Photographic Emulsions. A. van Kreveld and J. C. Scheffer. *Physica*, 4. *pp.* 76–80, *Feb.*, 1937. *In English.*—The emulsions investigated do not show a systematic change either of the latent image or of the sensitivity in the course of 14 months. AUTHORS.

1171. Border Effects Associated with Photographic Reversal Processes. G. W. W. Stevens and R. G. W. Norrish. *Phot. J.* 77. *pp.* 20–34; *Disc.*, 34–37, *Jan.*, 1937.—Experiments on the Sabattier effect (the partial or complete reversal found on plates diffusely re-exposed and redeveloped after previous exposure and development) are described, especially in relation to the light lines found at the borders of the final image. The relation between first and second exposure ranges to produce reversed or unreversed images is established; the line is found to arise for values of the first exposure in excess of that for which the final density is a minimum. The Sabattier effect has been attributed to a desensitisation of the undeveloped silver halide grains by the first exposure and development and, while the authors offer no explanation of the origin of this desensitisation, they show by experiments on the line-formation that it is not primarily due to products of development such as soluble halide or oxidation-products. The line-formation itself is primarily due to spread of light ("diffusion halation" or "irradiation") outside the borders of the image and is consequently most marked with coarse-grained and normally fine-grained emulsions (the first a reflection and the second a diffraction effect); between these there lies a range where the line is still present though less marked, while in "grainless" emulsions of the Lippmann type it is absent. In a *Discussion*, **E. R. Davies** described further experiments supporting this origin of the line-formation; both he and **F. F. Renwick** suggested that the so-called "desensitisation" was due, in part at least, to the screening effect of the first developed image during the second exposure. The authors referred also to lines associated with the Albert reversal and Clayden effects. L. V. C.

1172. Theory of Lippmann Colour Photography. K. F. Lindman. *Zeits. f. techn. Physik,* 18. 1. *pp.* 25–29, 1937.—Discusses the foundations of the theory considering the results of experiments performed with 26 cm. electric waves, dealing with the reflection and transmission powers of finely divided metal mirrors and several other types of thin layers, the phase variation of the electrical force by reflection at divided mirror surfaces and at other plane-parallel layers of different types, and refraction and absorption measurements. The conclusions drawn are then briefly shown to be satisfactory for the Lippmann photographic plates, considering the Ag particles in the gelatin lamellæ. R. C. F.

***1173. "Photoflux" Light-Source for Flashlight Photography. J. A. M. van Liempt and J. A. de Vriend.** *Philips Techn. Rev.* 1. *pp.* 289–294, *Oct.,* 1936.—The "Photoflux" is a light-source suitable for flashlight photography. It consists of a bulb containing oxygen in which a long wire of a combustible alloy is ignited electrically. This article deals with the method employed for measuring the quantity of light emitted and the luminous intensity as a function of the time. AUTHORS.

***1174. Chromatic Photography. D. Nukiyama.** *Imp. Acad. Tokyo, Proc.* 12. *pp.* 338–339, *Dec.,* 1936.—Photographing an object at a distance with light of a certain colour the contrast of the object with the background can be increased by using filters. These suffer from a defect in that a general blackening of the emulsion results owing to the light scattered by the grains of the filter. A camera is described which overcomes this by incorporating a prism in the optical system. Filters, with their accompanying scattering effect, are thus avoided. A. H.

***1175. Micrography of Metals in Ultra-Violet Light. J. Smiles and H. Wrighton.** *Roy. Soc., Proc.* 158*A*. *pp.* 671–681, *Feb.* 3, 1937.—U.v. light is particularly suitable for extreme resolution in alloys, since depth of focus is unimportant (in contrast to medical specimens), and reflecting power is usually high, especially for Al. Since the image is invisible, focusing difficulties are great, even with parafocal objectives and interchangeable holders, owing to the high magnification for which such illumination is used. A quartz objective specially computed with large curvature of the back lens to reduce glare, and free from spherical aberration, is used at full aperture with $\lambda = 2750$ Å from a condensed Cd spark. Negatives are not as contrasty as usual, probably due to absorption of u.v. rays in the gelatin. At ×2500 linear, under comparable conditions, images from a 1·7 mm. 1·25 N.A. quartz monochromat are a little better, in respect of definition and resolution than those from a new 1·6 N.A. visual monochromat working at $\lambda = 4395$ Å (deep blue), but in use the 24 % larger angular aperture of the latter may give crisper images.

Pearlite at 140,000 lines/in. is resolved by oil immersion, at 180,000 by the new visual objective. Final polishing of the alloys must be very fine and intermittent etching is desirable. Some non-metallic inclusions show selective absorption and a 4% Cu steel gives a transparent patina which completely masks the structure, being opaque to u.v. radiation. D. R. H.

See also Abstracts 962, 1248.

PHOTOMETRY.

*1176. **Brightness of Luminous Paint. W. H. Byler.** *Rev. Sci. Instruments*, 8. *pp.* 16–20, *Jan.*, 1937.—Deals with the use of the blocking-layer photo-cell as a photo-conductor for the measurement of very low brightnesses such as are obtained with luminous paints. After a brief description of the apparatus and method, and preliminary experiments, the use of short exposure and recovery times is discussed. Finally, using a standard paint for which the relation of conductance due to light to luminous flux has been determined, results of measurements on two other paints are given. The steps in cell calibration are (1) to determine the temperature coefficient, (2) to determine values of constant by measurement of dark conductance, (3) to determine, by means of a standard lamp, the "equilibrium" recovery time for various levels of illumination, (4) to determine series of conductance values due to light for different illuminations, and (5) to obtain an empirical equation for the results, the critical factor in the method being the timing. R. C. F.

See also Abstracts 1173, 1193.

POLARISATION.

1177. **Effect of an Electrical Field on the Polarisation of Raman Lines. R. Langenberg.** *Ann. d. Physik*, 28. 2. *pp.* 132–136, *Jan.*, 1937.—The effect of an intense alternating electric field on the polarisation of the Raman lines of benzene and toluene has been re-examined with improved technique and the effects reported by Sirkar [see Abstract 3688 (1934)] have not been confirmed. W. R. A.

1178. **Rotatory Power of Alkaline Solutions of Saccharose. K. Smoleński and W. Kozlowski.** *Acad. Polonaise Sci. et Lettres, Bull.* No. 7*A*. *pp.* 345–357, *July*, 1936. *In French.*—Measurements of the specific rotation of saccharose are made in solutions of various concentrations of saccharose with various concentrations of NaOH, and the molecular rotation is found to depend only on the pH of the solution. It is suggested that in the solutions the saccharose undergoes partial dissociation, forming a sodium salt, and that the ions have a lower rotatory power than the undissociated molecules. Treating saccharose as a weak dibasic acid with known dissociation constants, the rotatory powers of the solutions can then be predicted in good agreement with experiment. C. B. A.

1179. **Optical Rotatory Power and the Refractive Index of the Medium. H. G. Rule and A. R. Chambers.** *Chem. Soc., J. pp.* 145–153, *Jan.*, 1937.—An examination has been made of the changes in the rotatory power of optically active saturated and unsaturated hydrocarbons arising from variations in solvent, concentration, and temperature. For the saturated compound *d*-pinane the rotatory powers in *non-polar* solvents vary with the refractive index of the medium in agreement with

Born's expression, $M = k(n^2 + 2)^2$. Solutions in the great majority of *polar* solvents have lower rotations than the calculated values. Concentration effects in the latter cases are governed chiefly by the alteration in refractive index, but a small depression in rotatory power due to the polarity of the solvent is revealed by the influence of a rise in temperature. The rotatory power of the unsaturated hydrocarbon *d*-pinene appears to be raised in strongly polar solvents and lowered in those of high refractive index. The rotation of a solution in a non-polar medium does not show a linear relationship with the degree of concentration, pinene thus behaving as a polar compound. Temperature changes for polar solvents indicate a characteristic influence due to the polarity of the solute. In the case of the unsaturated hydrocarbon *d*-limonene, the rotations tend to rise in solvents of high refractive index, but the relationship is very irregular. Concentration changes in non-polar media show that limonene has the properties of a polar compound. AUTHORS.

See also Abstract 1201.

RADIATION, EMISSION.

1180. Energy Interchange between Solids by Radiation. C. H. Johansson. *Ann. d. Physik,* 28. 2. *pp.* 185–198, *Jan.,* 1937.—A methamatical treatment is developed in which Lambert's cosine law is assumed to hold good, and solutions obtained for the transfer of energy by radiation within a hollow space of any form and number of surfaces. Black-body radiation is dealt with first, complicated geometrical forms being replaced by an equivalent surface. A general expression is subsequently derived for any closed hollow space bounded by " gray " bodies. This is applied to certain particular cases. R. W. P.

1181. Cosmic Radiation and Solar Activity. H. T. Graziadei. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 7–8. *pp.* 495–502, 1936.—An attempt is made to correlate fluctuations of cosmic-ray intensity with solar activity, from a study of the results obtained on the three-year run (1932–1934) on the Hafelakar. Some correlation is found, both for the fully-shielded and the half-shielded conditions, between cosmic-ray intensity and the extent of the solar flocculi. A periodic variation of 27·2 days, corresponding to the period of rotation of the sun, is established. The maximum, however, occurs several days later than the maximum of the flocculi. D. H. F.

1182. Continuous Variation of Cosmic-Ray Intensity in the Higher Layers of the Troposphere. S. Ziemecki and K. Narkiewicz-Jodko. *Acad. Polonaise Sci. et Lettres, Bull. No.* 7*A*. *pp.* 318–326, *July,* 1936. *In English.*—Measurements made at heights from 6650 m. to 10,000 m. during a flight of the balloon "Warszawa II" on March 29, 1936, show no trace of such discontinuities as were found by G. A. Suckstorff [see Abstract 2866 (1934)] between 7000 m.–9700 m. The discontinuities found by that author may be due to the irregularities of the movement of electrometer threads, the electrometer not being sensitive enough for rapid measurements. The ionisation curve runs much steeper than that of Kolhörster and does not show a sharp maximum for the mass-absorption coefficient μ/ρ. AUTHORS.

1183. Cosmic Radiation. E. Regener. *Naturwiss.* 25. *pp.* 1–11, *Jan.* 1, 1937.—This paper is a survey of existing knowledge of cosmic radiation, from the experimental point of view. The author deals first with the variation of intensity with latitude and altitude, from both counter and ionisation chamber data, and discusses the absorption coefficient of the radiation. He then outlines the earlier results obtained with counters and cloud chambers, demonstrating the production of showers. Then follows an account of the determinations of the energy of the primary particles by measurements of the curvature of cloud tracks obtained in a powerful magnetic field. The variations of intensity with time are discussed at considerable length, and there is a brief note regarding the possibility of a biological effect of the radiation. D. H. F.

1184. Interaction of Particles of Very High Energy with Matter. L. Leprince-Ringuet. *Ann. de Physique*, 7. *pp.* 5–70, *Jan.*, 1937.—Little is known of the passage of electrons and protons of very high energies through matter, particularly in the region of energies of several million to 10 milliards of electron-volts. In the present work the two extremities of this waste range are studied. A Wilson chamber and magnetic field are employed for the investigation, a special large chamber being used for the particles of extremely high energy. The loss of energy of electrons which move in the field of atomic nuclei, the loss of energy which accompanies photon emission, and the variation of these effects as a function of electron energy are measured. It is found that for electrons of energies $1 - 3 \times 10^6$ eV passing through argon the results are ten times those calculated theoretically, which seems to indicate a supplementary absorption effect of electrons by matter. The law of absorption of the lower energy electrons of associated with cosmic radiation is established. The ultra-penetrating particles are studied by causing them to pass through 7 cm. of lead after passing through the Wilson chamber. The minimum energy necessary to traverse this thickness of absorber is 900×10^6 eV, and it is found that positively charged particles predominate for energies greater than 2·5 milliard eV. This confirms the hypothesis that there exists in the ultra-penetrating radiation a group of protons of very high energy. C. J. B. C.

1185. Energy Measurements of Cosmic-Ray Particles. L. Leprince-Ringuet and J. Crussard. *Comptes Rendus*, 204. *pp.* 112–115, *Jan.* 11, 1937.—About 500 tracks were measured in a counter-controlled cloud chamber in a magnetic field. With no absorbing medium in the path of the rays an energy-distribution in agreement with that found by other workers is recorded. With 14 cm. of Pb between the chamber and the counters a predominance of positive particles was found, particularly for energies $> 3 \times 10^9$ eV, and there was a greater proportion of undeviated rays than in the first case. With 14 cm. of Pb below the chamber approximately the same numbers of positive and negative particles were observed, with a smaller proportion of undeviated particles. The authors consider their results to be compatible with a variation of absorption with energy. Special mention is made of exposures showing a secondary originating in the gas in the chamber and a shower of about 200 particles. D. H. F.

1186. Hoffmann "Bursts." A. Dauvillier and A. Rogozinski. *Comptes Rendus*, 204. *pp.* 143–145, *Jan.* 11, 1937.—Millikan's theory [see Abstract 1135 (1934)] that these "bursts" are accidental and due to ionisation is disproved. C. A. S.

1187. Cosmic-Ray Showers. Hu Chien Shan. *Roy. Soc., Proc.* 158*A*. *pp.* 581–590, *Feb.* 3, 1937.—To detect showers a group of five counters, arranged at the corners of a regular pentagon, was used. Pb was arranged hemispherically about the counters as axis, and readings were taken for two values of the radius of the hemicylinder, such that the counter system recorded all showers for which the angle of divergence of the constituent particles was greater than 3° and 15° respectively. In the first case a sharp maximum at 1·4 cm. of Pb was found, in the other a much flatter maximum at nearly the same thickness. This does not support the expectation that the angle of a shower is larger when the average range of the shower rays is smaller. It was found that the number of showers observed decreased steadily as the separation of the counters was increased. The initial part of the transition curves for Pb, Sn, Zn and Al was studied. If the rate of coincidences is plotted against nZ^2, n being the number of atoms per unit surface of shower-producing material, Z the atomic number, the initial parts of the transition curves for the different elements are nearly the same. The common curve has an upward concavity with a finite initial slope different from zero. D. H. F.

1188. Absorption of Cosmic Radiation in Matter. A. W. Nye. *Frank. Inst., J.* 223. *pp.* 173–178, *Feb.*, 1937.—The paper describes absorption and shower producing effects of cosmic radiation in water, coal, copper sulphate, iron sulphide, sand and barium sulphate. The measurements were made with triple coincidence Geiger counters, near sea level. The coefficient of absorption was not found to be strictly proportional to density, substances of higher atomic number showing departures. The coefficients per bound electron was found to be constant, within the precision of the observations. Showers were found to follow the direction of the primaries, and to show maxima with increasing thicknesses of shower-producing matter in the region of 50–100 gm./cm.^{2} of material. AUTHOR.

1189. Intensity of Cosmic-Rays in the Earth's Crust. Test of Super-Nova Hypothesis. J. Clay, C. G. 't Hooft, L. J. L. Dey and J. T. Wiersma. *Physica,* 4. *pp.* 121–137, *Feb.*, 1937. *In English.*—An experimental test of the super-nova hypothesis was made by measurements in the coal-mine at Kerkrade at depths of 46, 102, 143 and 260 m. The systematic variations, calculated by Zanstra, proved to be of the same order as the unsystematic variations found. A variation of 0·04 % of the hour ionisation charge at sea-level could be measured. At 200 and 260 m. the intensity of rays is less than 0·001 of the intensity at sea-level. A separate group of very hard rays is found of which the rays hardly decrease in number and in ionisation between 102 m. (230 m. water-equivalent) and 143 m. (328 m. water-equivalent). The Hoffmann bursts could be recorded at various depths. The decrease in number and intensity was found between sea-level and 328 m. water-equivalent. The decrease in the magnitude of the bursts shows that the burst-producing rays possess a specific ionisation which is about 100 times the ionisation of high energy electrons. The burst-producing rays may therefore be neutrons. Burst and showers are essentially different. AUTHORS.

1190. Production of White Light with a Single Luminous Tube. G. Claude. *Comptes Rendus,* 203. *pp.* 1203–1206, *Dec.* 7, 1936.—The author reviews the various methods which are being developed by French investigators to obtain white light from a single luminous discharge tube. Besson's method employing two fluorescent materials, one coated inside, the other outside the tube, is briefly described, and a fuller account is given of the work of A. Claude and M. Servigne [see following Abstract] on the use of Sm as an additional phosphorogen for calcium tungstate. Both methods yield sensibly white light with a luminous efficiency of 20 to 30 lumen/W. W. S. S.

1191. Luminescence Phenomena Bearing on the Production of Sensibly White Light. M. Servigne. *Comptes Rendus,* 203. *pp.* 1247–1249, *Dec.* 7, 1936.—The author studied the fluorescent light emission of calcium tungstate and calcium molybdenate contained in a Hg discharge tube and investigated in particular the effect of traces of Sm introduced into the calcium salts as a phosphorogen in addition to the Ag impurity. Sm gives rise to wide lines in the orange red which increase in intensity with the amount of Sm added up to a certain point while at the same time the band in the blue due to other phosphorogens present (Ag) undergoes a corresponding weakening. The blue band is also reduced in intensity in the presence of a fixed amount of Sm if the temperature is raised while the Sm lines remain unaffected. By suitable control of the temperature of the tube and of the amount of Sm, a light emission of resultant colour closely approximating to white is obtainable. This radiation, however, is deficient in the green. An actual energy match with solar radiation can be achieved by adding synthetic willemite to the tungstate-Sm mixture. [See preceding Abstract.] W. S. S.

1192. Production of White Light by the Electrical Luminescence of Gases. M. Laporte. *Comptes Rendus,* 203. *pp.* 1341–1342, *Dec.* 14, 1936.—Ultra-high-pressure gas-discharge tubes employing very high current density give a spectrum very rich in lines and containing also a continuous background, but they suffer from the disadvantage that the power dissipated per unit length of tube is very high and in some cases water-cooling is necessary. The author suggests using high current densities to obtain a white light emission but allowing the discharge to pass through the tube only for a very short time in each cycle. This is accomplished by placing the tube in series with a thyratron across the plates of a condenser connected to the secondary of a suitable transformer. Using this principle a metre tube consuming 1500 W and giving 12,000 lumens has been realised. The gas used was Xe. The duration of each light flash was found to equal 12 μs., the flashes being repeated 50 times a sec. Since the " average " candle-power equals 1000, the intensity during the flash must be extraordinarily high. W. S. S.

***1193. Discharge Tube as Standard of Radiation. H. Krefft, F. Rössler and A. Rüttenauer.** *Zeits. f. techn. Physik,* 18. 1. *pp.* 20–25, 1937.—Examines the suitability of the high pressure Hg discharge lamps in quartz as a standard of radiation. A number of lamps were made to a rigid specification as regards dimensions and other quantities and it was found that the radiation in the various wave-lengths was reproducible by adjusting the electrical input. The reproducibility was of the order of 4 % and the constancy during a run was of the same order. By using the average value of a number of lamps a higher degree of accuracy can be attained. Details of the special design of the lamps (250 W) are given. J. W. T. W.

RADIATION, GENERAL THEORY.

1194. Free Particles, Photons and Particles of " Pure Charge." A. Proca. *J. de Physique and le Radium,* 8. *pp.* 23–28, *Jan.,* 1937.—The author further develops his theory of the mechanics of the ultimate particles of matter and radiation [see Abstracts 4350 and 5539 (1936)]. He shows that a photon may be regarded as two particles of " pure charge " superposed. These particles have zero proper mass, equal positive energy and equal momentum and spin. But they have different charges and opposite electromagnetic moments. G. C. McV.

1195. Production of Electromagnetic Waves by Neutrinos. J. Géhéniau. *Comptes Rendus*, 204. *pp.* 235–237, *Jan.* 25, 1937.—The production of electromagnetic waves by Dirac waves [see Abstract 209 (1937)] is treated in terms of a derived antisymmetric tensor, and the conditions satisfying Maxwell's equations are deduced. The conclusion is reached that the energy liberated during the association of two neutrinos having different ω has the form of a Maxwell electromagnetic wave. N. M. B.

See also Abstract 1046.

REFLECTION, REFRACTION AND DISPERSION.

1196. Geometrical Theory of Reflection at Curved Surfaces. H. Horninger. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 6. *pp.* 367–385, 1936.—A systematic geometrical investigation of reflection phenomena is made on the basis of the properties of the reflection congruence arising from reflection of a bundle of rays. In this way, already established results on the algebraic characteristics of reflection at algebraic surfaces are further elucidated, and the results can be applied to the case of reflection at surfaces of the second degree. Multiple reflection is also discussed. C. B. A.

1197. Indicatrix of Reflecting Powers of Transparent and Semi-Transparent Crystals. L. Capdecomme and G. Jouravsky. *Comptes Rendus*, 204. *pp.* 137–139, *Jan.* 11, 1937.—The authors point out that in general the indicatrix is not an ellipse. This is verified by measuring the reflecting power of a suitable crystal of high dispersion and low absorption and by comparing the results with the values calculated on the assumption that the indicatrix is an ellipse as well as on the basis of the theroetical formula $R = Rg\cos^2\alpha + Rp\sin^2\alpha$. The calculations show that only the latter values agree with those observed. The measurements were made in blue, yellow and red light and the difference between the two calculated values increases as the wave-length of the light increases. J. I.

***1198. Measurement of Gloss. R. S. Hunter.** *Bureau of Standards, J. of Research*, 18. *pp.* 19–39, *Jan.*, 1937.—The author distinguishes six different kind of gloss [see Abstract 2182 (1936)]. The directional distribution of the light reflected from a surface illuminated under specified conditions is the fundamental basis for describing gloss but for many purposes this is cumbersome, and instruments based on more empirical lines have been designed and used in practice. By trial and error, methods have been found to measure the gloss of particular types of materials, *e.g.* paper, textiles, paint, etc. The author suggests that the designer of a glossmeter to be used for a particular material should determine, from light distribution data obtained with representative samples, what differences in apparent reflection factor are most characteristic of the differences in gloss as observed visually and should design the instrument accordingly. The paper includes descriptions of typical glossmeters and a full Bibliography of the subject. J. W. T. W.

1199. Optical Reflectivity of Metals in the Supraconducting State. E. Hirschlaff. *Cambridge Phil. Soc., Proc.* 33. *pp.* 140–144, *Jan.*, 1937.—Measurements of the reflection coefficient at normal incidence on Pb and Ta mirrors in the supraconducting and non-supraconducting state did not reveal any change within the limits of accuracy (0·2–0·5 % in

R). This does not agree with a suggestion of Kronig [see Abstract 5170 (1935)], according to which an increase in reflectivity of about 35 % could have been expected. AUTHOR.

1200. Optical Changes in Freshly Evaporated Aluminium-Magnesium Films. H. W. Edwards and R. P. Petersen. *J.O.S.A.* 27. *pp.*87–91, *Feb.*, 1937.—This paper deals with experimental observations of the reflection and transmission characteristics of freshly evaporated films of an Al-Mg alloy (Al 95 %, Mg 5-%). Appropriate apparatus was arranged inside an evaporation chamber so that measurements could be made during and after the deposition of the metallic film. Three types of changes in the reflection and transmission coefficients for white light were observed to take place. (1) The first type (occurring at pressures of 10^{-4} mm. or less) consists of a small rapid decrease in reflectivity and increase in transmissivity. No further effect was observed to take place in the vacuum. (2) The second type occurs during the admission of air or other gases into the vacuum chamber. Similar to the first change, this consists of a decrease in reflectivity and an increase in transmissivity. (3) The third type takes place very slowly and over a period of several days. The final value of the reflection or transmission coefficient is approached asymptotically. In a typical case the magnitudes of the three types of changes for a film having an initial reflection coefficient of 58 % were observed to be 8, 5, and 10% respectively; and for another film having an initial transmission of 35 % were 5, 8 and 5 %. AUTHORS.

1201. Optical Investigation of Thin Ag and AgI Films. G. Essers-Rheindorf. *Ann. d. Physik*, 28. 4. *pp.* 297–318, *Feb.*, 1937.—A new method of estimating the thickness of thin transparent and absorbing layers directly from polarisation measurements is described. It is compared with the method of Newton rings for a large number of Ag and AgI films, and it is shown that the results obtained by the two methods agree to within ± 10 %. Further the optical constants of Ag are measured for varying film-thicknesses, and similar results are obtained with Ag films prepared by two different methods. The observed dependence of the optical constants upon film thickness agrees qualitatively with earlier measurements. The refractive index of AgI is determined for a range of film thicknesses, and it is found that the value decreases as the thickness is made less than about 15mμ. A. G. Q.

1202. Hamilton's Method in Geometrical Optics. J. L. Synge. *J.O.S.A.* 27. *pp.* 75–82, *Feb.*, 1937.—Discusses the current misconception that whilst Hamilton invented a very elegant but inapplicable method in geometric optics (that of the characteristic function) Bruns later developed a similar relation (that of the eikonal) which led to practical applications, whereas that of Hamilton had not. It is pointed out that Bruns invented no new method but rediscovered Hamilton's method in a less general form. Hamilton's method is then discussed in detail. A. H.

1203. Absence of Fresnel's "Most Useful Effect" in the Hyperbolic Reflector. L. E. Dodd. *J.O.S.A.* 27. *pp.* 92–94, *Feb.*, 1937.—In Fresnel's analysis of the parabolic reflector, considering finite size of source he defined a quantity he called the useful effect. The present paper applies Fresnel's test to the hyperbolic reflector. It is shown mathematically that for the hyperbola the useful effect reaches no maximum except for degenerate cases. AUTHOR.

1204. Optical Imagery. J. Picht. *Die Physik*, 5. 1. *pp.* 23–32, 1937.—A report, with Bibliography, of work in geometrical optics since

1933. The following subjects are reviewed: general theoretical problems, the practical computation of optical systems, experimental determination of aberrations and data for optical systems, influence of diffraction on image formation, and the geometrical optics of non-homogeneous media. C. B. A.

1205. Refractive Indices and Dispersions of Gases and Vapours. K. L. Ramaswamy. *Indian Acad. Sci., Proc.* 4*A. pp.* 675–686, *Dec.*, 1936.—Refractive indices and dispersions are measured for 16 gases and vapours using a Zeiss interferometer of the Rayleigh type. Five wave-lengths 6440, 5462, 5087, 4801 and 4360 are employed for the purpose. Accurate values of compressibilities for the gases and approximate values for the vapours are obtained by studying the variation of refractive index with pressure. The electronic polarisations obtained in this paper are compared with the dielectric polarisations given in the earlier paper [see Abstract 4840 (1936)] and from the two the atomic polarisations are calculated. The values of refractive index for the gases and vapours by the author are compared with existing data by others and discussed. Refractivities in the liquid state for substances which are liquids at the ordinary temperature and pressure are measured for two wave-lengths using a Pulfrich refractometer and a Hg arc. These values are compared with those obtained for the corresponding vapours. The results show that in general the refractivities of the vapours are slightly higher than those of the liquids. The dispersions in the liquid and vapour states are compared. The indications are that the values in the vapours are slightly higher than in the corresponding liquids. AUTHOR.

1206. Refractivity and Density of Distilled Water as a Function of Temperature. L. W. Tilton and J. K. Taylor. *Bureau of Standards, J. of Research*, 18. *pp.* 205–214, *Feb.*, 1937.—For a given wave-length, an equation of the form $n_t - n_{20} = -\{\bar{B}(t-20)^3 + \bar{A}(t-20)^2 + \bar{C}(t-20)\}/(t+\bar{D}) \times 10^7$, an adaptation of the type of equation used by Thiesen for representing data on the density of water, has been compared with four- and six-parameter polynomials in t as a means for expressing thermal variations in the refractivity of water. All adjustments were made by the method of least squares with a precision of a few parts per million. This type of equation has also been fitted to the data obtained by Chappuis on the density of water at the International Bureau of Weights and Measures in 1891 and 1897. It fits them better than do his tabulated values. All results are examined statistically, a revised table of the density of water is given, and it is concluded that this type of equation is superior to a power series for representing either the refractive index or the density of distilled water. AUTHORS.

***1207. Prisms for Straight Vision. J. Picht.** *Zeits. f. Instrumentenk.* 57. *pp.* 60–64, *Feb.*, 1937.—Prisms for straight vision have usually the disadvantage that the width of the transmitted beam is less than the height of the prism. A new prism is described which avoids this by using two sorts of glass which, for a certain wave-length, have equal refractive index. Light of this wave-length passes without deflection through the internal faces, and also through the end faces which are perpendicular to the beam. The loss of dispersion by the compensating effect of the two materials is made up by using large angles of incidence. R. P.

See also Abstracts 1046, 1085, 1175, 1179.

SPECTROSCOPY.

1208. Broadening of Spectral Lines in a Homogeneous Gas. (Coupling Width.) W. Furssow and A. Wlassow. *Phys. Zeits. d. Sowjetunion,* 10. 3. *pp.* 378–412, 1936. *In German.*—Reasons are put forward for regarding the existing theory of the broadening of spectral lines in a homogeneous gas as invalid, and in place of it a rational explanation is advanced of the large broadening, on increase of pressure of the basic gas, according to which this broadening results from two main causes; firstly, the increased decay of atoms resulting from the giving up of energy to neighbouring atoms, and secondly, the change of amplitude of oscillation, with respect both to magnitude and sign, at small distances in the wings of lines. Both a classical and a quantum theoretical treatment of the problem are given. The theoretical results are found to be in good agreement with experiment. Considerations are put forward which permit a qualitative investigation of the influence on the form and width of lines of the radiation which appears during collisions. J. E. K.

1209. Light Excitation by Bombardment of Positive Cæsium Ions by Helium Atoms. W. Maurer. *Zeits. f. Physik,* 104. 1–2. *pp.* 113–121, 1936.—An improved technique is described [see Abstract 4699 (1936)]. A mixture of Cs_2CO_3, Al_2O_3 and SiO_2 is used for emitting the ions. Graphs are given showing the dependence of current and pressure on excitation. The excitation functions of various lines of CsII and HeI are recorded and discussed. W. R. A.

1210. Spectra of Elements Ti to Fe, Similar to SI : Ti VII, V VIII, Cr IX, Mn X, Fe XI. B. Edlén. *Zeits. f. Physik,* 104. 3–4. *pp.* 188–193, 1937.—Vacuum spark spectra of the elements of the first long period are photographed using an instrument of high dispersion in the region below 200 Å. Numerous related lines are identified in the spectrum of each element and the results, when applied to the Goudsmit hypothesis, show good agreement. Values for the ionisation potentials are found by extrapolation. [See also Abstract 663 (1937).] W. R. A.

1211. Electric Explosion Spectrum of Metals. T. Futagami. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 671. *pp.* 1–29, *Jan.,* 1937. *In English.*—In order to investigate the behaviour of the spectrum of a rapidly changing light source, a new spectrograph with a photographic film rotating at high speed is employed. The electric explosion spectra of wires of Cu, Ag, Mg, Ca, Zn, Cd, Hg, Al, Tl, Sn, Pb and Bi emitted at the beginning of the discharges are photographed in this way, and spectrograms and the corresponding microphotometer curves are given. The spectra consists of arc and spark lines, the former being generally reversed, but the latter not. Full data are tabulated for each metal. The characteristics of the spectra emitted at the first phase of the oscillations are broadening, bending, and weakening. An indication of complex structure is noticed in a few lines. The physical nature of the emitting vapour is considered and the effective temperature, pressure, and strength of the electric field developed in the vapour at the first state of discharge are estimated. N. M. B.

1212. Spectrum of Ionised Tellurium, Te III. S. G. Krishnamurty and K. R. Rao. *Roy. Soc., Proc.* 158*A. pp.* 562–570, *Feb.* 3, 1937.—With a view to extending the analysis of Te III previously undertaken by the authors [see Abstract 3486 (1935)] further experiments with suitably modified discharge tubes have been conducted, and the results obtained have led to the identification of the terms due to the sp^3, $6d$, and $7s$ configurations. More than 100 lines have newly entered the scheme for Te III. Interesting deviations from the normally expected characteristics are recorded. AUTHORS.

1213. Influence of Pressure on the Radiation from Discharges in Mercury and Cadmium Vapour. W. Fabrikant, A. Kanel and F. Butaewa. *Phys. Zeits. d. Sowjetunion*, 10. 3. *pp.* 315–336, 1936. *In German.*—The intensities of a few important lines in the discharge spectra of Hg and Cd vapour are measured at pressures ranging from 10^{-4} to 10 mm. Starting from the lowest pressure the intensity/pressure curves in this range are found in all cases first to rise to a maximum then to descend and pass through a minimum and finally ascend again towards the highest pressures. By comparison of the intensity curves for lines having either common lower levels or common upper levels the influence of re-absorption and of the excitation potentials can be explained. With increasing pressure it is found that a change takes place in the angular distribution of the emitted light, an effect for which a simple theoretical explanation is proffered. [See also Abstract 3201 (1936).] J. E. K.

1214. Isotope Displacement in the Neon Spectrum. R. Ritschl and H. Schober. *Phys. Zeits.* 38. *pp.* 6–9, *Jan.*, 1937.—The hyperfine structure of 72 lines of the Ne spectrum is investigated, the spectrum being excited by a discharge in a specially prepared sample of the gas containing the isotopes Ne^{20} and Ne^{22} in the ratio 1 : 2. In all cases the lines of the two isotopes are clearly resolved the Ne^{22} component being of longer wave-length than the Ne^{20} component. The isotope displacements of the energy terms are calculated on the assumption that there is no displacement in the high $8s_5$ term. Term displacements are found to be roughly proportional to the term magnitude but nevertheless to show a decided dependence on the nature of the term sequence. J. E. K.

1215. Nuclear Spins and Magnetic Moments in the Hartree Model. M. E. Rose and H. A. Bethe. *Phys. Rev.* 51. *pp.* 205–213, *Feb.* 1, 1937.—From the results of Feenberg and Wigner for the wave function and term character of the ground state of light nuclei (mass number between 6 and 16), the nuclear spins are determined. For those nuclei which contain (or lack) a single proton (or neutron) and an even number (singlet state) of particles of the other kind the considerations of Inglis suffice to determine the spin. For those nuclei which contain a half-filled p shell in one kind of particle it is necessary to calculate the fine structure splitting explicitly. From the spins thus found and with the experimental values for the magnetic moments of the proton and neutron, the nuclear magnetic moments are calculated. The effects on the nuclear moment of the Heisenberg forces and of the motion of the $1s$ shell are considered. The moment of Li^7 which is of particular interest, is calculated to be 3·07 nuclear magnetons. This is in agreement with the measured value of 3·20. AUTHORS.

1216. Mean Life of the Zinc Atom in the 2^3P_1 State. P. Soleillet. *Comptes Rendus*, 204. *pp.* 253–255, *Jan.* 25, 1937.—A discussion of the results of other workers. It is concluded that the mean life is $2{\cdot}1 \times 10^{-5}$ sec. A. H.

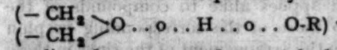
1217. Formation of Activated Water Molecules in the Oxy-hydrogen Flame. T. Kitagawa. *Imp. Acad. Tokyo, Proc.* 12. *pp.* 281–284, *Nov.*, 1936. *In English.*—O_2 is burned at a quartz jet in a H_2

atmosphere and the red outer flame is studied. A large number of complex bands, degraded to the red, are observed between λλ5650 and 7000. These are attributed to the H_2O molecule. The emission spectrum is compared with the absorption spectrum obtained from water vapour at a temperature of 144° C. (pressure being about 4 atm.) and it is believed that there is a certain similarity. The mechanism of the reaction between O_2 and H_2 is considered assuming the spectrum to be that of the H_2O molecule. A. H.

1218. Band Spectrum of Gold Hydride. T. Helmer. *Zeits. f. Physik*, 104. 3. 4. *pp*. 303–308, 1937.—Previous work on AuD [see Abstract 3673 (1936)] is extended to AuH, the arc emission spectrum of which is photographed with a concave grating giving a dispersion of 1·95 Å per mm. New nuclear vibrational levels $v' = 3$ and 4 and $v'' = 4$ and 5 are determined for the known $^1\Sigma^* - {}^1\Sigma$ system. Dissociation energies and isotopic effects are also calculated. L. A. W.

1219. Infra-Red and Raman Spectra of Derivatives of Nitrogen. (Mme) M. Freymann and R. Freymann. *J. de Physique et le Radium*, 7. *pp*. 506–510, *Dec*., 1936.—Primary and secondary amines and non-substituted amides exhibit in the near infra-red and in their Raman spectra intense NH bands, but mono-substituted amides R.CONH.R only exhibit very weak bands. This phenomenon is discussed in the light of the possibility of chelation. Sidgwick's explanation is compared with that based on the presence of single electron bonds, the latter seeming to be more satisfactory. The phenomenon of dissimulation observed in aqueous solutions of substances where nitrogen is tetracoordinated is also discussed. C. B. A.

1220. Infra-Red Absorption Spectrum of Ammonia between 6000 and 9500 Å. G. Costeanu and P. Barchewitz. *Comptes Rendus*, 203. *pp*. 1499–1501, *Dec*. 28, 1936.—The third and fourth harmonics of the 3μ band of NH_3 have been studied for liquid NH_3 at − 75° and for gaseous and dissolved NH_3 at ordinary temperatures. Four bands in liquid NH_3 are probably related to the prominent Raman frequency of 3380 $cm.^{-1}$. [See also Abstract 1587 (1936).] W. R. A.

1221. Near Infra-Red Absorption Spectra of Alcohol Solutions in Ether and Dioxane. R. Freymann. *Comptes Rendus*, 204. *pp*. 41–43, *Jan*. 4, 1937.—In solutions of alcohols and phenols in CCl_4 and C_6H_6 the intensity of the OH band 0·96μ increases owing to decrease in molecular association; in ether and dioxane the band either disappears or is very weak. In solutions of H_2O in dioxane the band is considerably weakened. These results are interpreted by the formation of an oxonium compound  $\left.\begin{matrix}(-CH_2\\(-CH_2\end{matrix}\right> O\ldots o\ldots H\ldots o\ldots O\text{-}R)$ with a monoelectronic linkage intermediate between covalence and electrovalence. Acetone behaves like ether and dioxane. The phenomenon limits the application of these solvents in the measurement of absorption, dielectric constant, etc. H. G. C.

1222. Infra-Red Absorption Spectrum and the Molecular Structure of Pyruvic Acid. P. Bayard. *Comptes Rendus*, 204. *pp*. 177–179, *Jan*. 18, 1937.—The absorption of pyruvic acid between 0·8μ and 2·5μ is examined and compared with the spectra of various compounds analogous to the keto- and enol-forms of the acid. Most of the bands are attributed to CH, CO, or C = C vibrations. The carbonyl and carboxyl CO groups cannot be distinguished by the measurements. An OH band which appears in the alcohols but not in the acids probably arises from the enol form. Pure pyruvic acid is chiefly in the keto form, but a certain proportion exists in the enol form. H. G. C.

1223. Infra-Red Absorption by Hydrogen Sulphide. A. D. Sprague and H. H. Nielsen. *J. Chem. Phys.* 5. *pp.* 85–89, *Feb.*, 1937.—Two of the bands in the spectrum of H_2S indentified as ν_3 and ν_2 have been remeasured under high dispersion. The centre of the band identified as ν_3 is found to be 2685 cm.$^{-1}$ and is a type of band showing no single *Q* branch at the centre and is therefore ascribed to an oscillation of the electric movement along the axis of the intermediate moment of inertia. The fundamental ν_2 has been remeasured with two different gratings of different resolving power. It has been found to be of the type displaying a broad and partially resolved *Q* branch at the centre and is henceforth indentified with an oscillation of the electric moment along the axis of smallest moment of inertia. An estimate of the values of the moments of inertia has been made and these are found to agree well with those given by Cross, but the data here presented are interpreted as evidence for a model where the vertex angle is 85° rather than 92° as given by Cross. AUTHORS.

1224. Absorption Spectra of Aqueous Solutions between 0·70 μ and 0·90 μ. Part II. E. Ganz. *Zeits. f. phys. Chem.* 35. *Abt. B.* 1. *pp.* 1–10, 1937.—The exact position of the 0·77 μ water band depends upon the size of ions in solution, the shift being proportional to the radius. Not only does it depend on size but also on structure. This suggests a quasi-crystalline structure for water in the liquid state. The influence of temperature on the shift of maximum absorption is also investigated and discussed. [For Part I see Abstract 4194 (1936)]. F. S.

1225. Absorption and Fluorescence Spectra of Indium Vapour. R. Wajnkranc. *Zeits. f. Physik,* 104. 1–2. *pp.* 122–131, 1936.—The presence of In_2 molecules in the vapour has been confirmed by investigating the spectra between 600° and 1000°. In the absorption spectrum, as well as lines of atomic In, there occur two groups of sharp bands, three continuous bands, and a group of diffuse bands are found. In fluorescence only atom lines are found and their origin may be connected with predissociation. W. R. A.

1226. Absorption of Light by Porphyrins. Part X. A. Stern and H. Molvig. *Zeits. f. phys. Chem.* 178. *Abt. A.* 3. *pp.* 161–183, 1937.—Continuing previous work [see Abstract 5151 (1936)] the authors investigate the absorption spectra of further substituted chlorins. A comparison of the absorption spectra of pyrroporphyrin and meso-pyrrochlorin leads to a new allocation of the bands which applies alike to compounds of the chlorin (or phorbin) system and to those of the corresponding porphin system. Conclusions are drawn as to the arrangement of the rings in these types of molecules. In HCl solution the chlorins and meso-chlorins are observed to possess four bands, which can be related to those of the corresponding porphyrins in HCl and to those of the chlorins or meso-chlorins in neutral solution. L. A. W.

1227. Effect of Foreign Molecules on Absorption Coefficient of Oxygen in the Schumann Region. E. G. Schneider. *J. Chem. Phys.* 5. *pp.* 106–107, *Feb.*, 1937.—The absorption coefficient of oxygen in the continuous band having a maximum at 1450 Å is not altered by the addition of 80% N_2 at pressures less than 15 mm. of Hg, the range covered by these experiments. The conclusion is drawn that, at least at low pressures, the absorption of O_2 in the Schumann region is not affected by collisions with foreign molecules. AUTHOR.

1228. Ultra-Violet Absorption Spectra of Complex Aromatic Hydrocarbons. Part II. W. V. Mayneord, and E. M. F. Roe. *Roy. Soc., Proc.* 158*A*. *pp.* 634–650, *Feb.* 3, 1937.—The u.v. absorption spectra of ethyl alcohol solutions of a number of polycyclic aromatic compounds, some of which are of biological importance, have been investigated. The compounds examined include equilin, oestrone, oestradiol, hexahydrophenanthrone, 9 : 9 : 10 : 10-tetramethyl-9 : 10-dihydro-1 : 2 : 5 : 6-dibenzanthracene, cholanthrene, 6-*iso*propyl-1 : 2-benzanthracene, fluorene, 1 : 2- and 3 : 4-benzfluorenes, 1 : 2 : 5 : 6-dibenzfluorene, 1′ : 2′-naptha-2 : 3-fluorene and 3 : 4-benzphenanthrene. A quantitative technique is described for measurements at low temperatures and results with benzene solutions are recorded. Preliminary qualitative experiments on naphthalene, anthracene, and phenanthrene are reported. [For Part I see Abstract 5033 (1935)]. AUTHORS.

1229. Fourth Positive Band System of CO in the Schumann Region. W. M. Tschulanowsky and B. I. Stepanow. *Phys. Zeits. d. Sowjetunion,* 10. 3. *pp.* 292–314, 1936. *In German.*—A number of bands of this group are analysed. The values of the rotation constants for the corresponding electronic states, which had already been given by other authors, are improved. A large number of perturbations are found and the perturbing levels are traced. In these calculations a modification of the usual method was employed. R. P.

1230. Rotation Analysis of the O_2^+ $^2\Pi - {}^2\Pi$ Bands. L. v. Bozóky. *Zeits. f. Physik*, 104. 3–4. *pp.* 275–290, 1937.—The bands were produced by h.f. excitation and resolved with a 6·5 m. grating of 1·2 Å/mm. dispersion. The bands examined lie at 4363·1, 4081·7, 3299·6, 2580·8, 2532·7, 2381·0 and 2343·0 Å and the rotation constants for $v' = 0, 1, 5, 6, 7, 8$ and for $v'' = 1, 2, 5, 8, 9$ are calculated. The values do not quite agree with previously published values. The moments of inertia and nuclear distances now found are $I_e' = 26{\cdot}0902 \times 10^{-40}$ cm^2 gm., $I_e'' = 16{\cdot}5650 \times 10^{-40}$ cm^2 gm., $r_e' = 1{\cdot}406 \times 10^{-8}$ cm. and $r_e'' = 1{\cdot}121 \times 10^{-8}$ cm. F. S.

1231. Emission Band Spectrum of Chlorine. Part I. A. Elliott and W. H. B. Cameron. *Roy. Soc., Proc.* 158*A*. *pp.* 681–691, *Feb.* 3, 1937.—The wave numbers of the band heads of the chlorine emission spectrum, and of the maxima of the continua excited by a h.f. discharge, have been measured. The analysis of the band system proposed by Ota and Uchida (*Japanese Journ. Phys.* 5. p. 53, 1928) is shown to be untenable but no alternative analysis is put forward. The vibrational isotope effect shows that there is a system whose origin is at 21,000 cm.$^{-1}$, and probably a second system with origin at 21,340 cm.$^{-1}$. AUTHORS.

1232. Infra-Red Absorption Spectra and Vibration Modes of Compounds Containing an Ethylenic Linkage. J. Lecomte. *Comptes Rendus,* 203. *pp.* 1501–1503, *Dec.* 20, 1936.—The infra-red spectra of some 40 widely-different ethylenic compounds in the region 510 cm.$^{-1}$ to 1450 cm.$^{-1}$ are discussed. Certain bands appearing in allyl derivatives can be interpreted only by assuming two distinct molecular forms. By comparing corresponding saturated and unsaturated compounds, it is shown that the ethylenic linkage effects a considerable displacement of absorption bands throughout the spectrum. W. R. A.

1233. Force Constants and Fundamental Vibrations of Diacetylene. Ta-You Wu and S. T. Shen. *Chinese J. of Physics*, 2. *pp.* 128–134, *Dec.*, 1936. *In English.*—The assignment of the fundamental frequencies of C_4H_2 given by Timm and Mecke [see Abstract 2587 (1935)] is discussed and a new assignment in accord with the selection rules is suggested. Nine force constants for the molecule are calculated according to Timm and Mecke's assignment, while the new assignment gives no reasonable constants for the deformation vibrations. Further study of the Raman spectrum and the infra-red absorption is necessary for a final classification of the deformation frequencies. AUTHORS.

1234. Fine Structure and Irregularities in the Rotation-Vibration Spectrum of Acetylene. G. W. Funke. *Zeits. f. Physik*, 104. 3–4. *pp.* 169–187, 1937.—Examination of the rotation-vibration spectrum of C_2H_2 with an instrument of high dispersion reveals the fine structure and irregularities associated with the main vibrational absorption bands in this region. Two new bands are reported at 8678 and 8640 Å. These, like the band at 9645 Å, are associated with extensive fine structures possessing irregularities. The origin of the phenomenon is discussed. W. R. A.

1235. Calculation of the Ultra-Violet Absorption Frequencies of the Alkali Halides. T. Neugebauer. *Zeits. f. Physik*, 104. 3–4. *pp.* 207–218, 1937.—The calculations of the characteristic absorption frequencies of the alkali halides made by Wolf, Herzfeld and Klemm are extended by the inclusion of the contributions to the polarisation energy arising from the inhomogeneity of the field of the ions. In evaluating the integrals which result in the case of NaCl, the new Hartree values for the distribution of charge in the Cl^- ion are employed. It is found that much smaller energies are required for the alkali atoms formed than had previously been assumed. The contributions to the energy which are still not taken into account are discussed. C. B. A.

1236. Increase in Degeneracy of Normal Vibration Frequencies by Interaction between Molecules. G. Briegleb and W. Lauppe. *Zeits. f. phys. Chem.* 35. *Abt.B.* 1. *pp.* 42–59, 1937.—The van der Waals forces operating between molecules of a liquid, solution or molecular compound give rise to changed symmetry relations in the molecule. Thus, in carbon-linked molecular compounds, of molecules having unsymmetrical groupings, the interaction between the groups of the primary compounds cause intramolecular potential changes. There is an enhancement of dipole moment in symmetrical compounds such as $SnCl_4$ when dissolved in organic solvents and this is attributable to deformed valency angles. The effect can be observed by a corresponding change in Raman spectra and is particularly marked in molecular compounds of $AlCl_3$ and ethers, an observation probably related to the strong catalytic activity of $AlCl_3$. W. R. A.

1237. Continuous Flame Spectrum of Potassium. T. N. Panay. *Comptes Rendus*, 204. *pp.* 251–253, *Jan.* 25, 1937.—A potassium flame gives a continuous spectrum in the visible and u.v. regions. A good way of producing this spectrum is to introduce a current of air containing finely divided KCl into the flame, such a source is very steady. The varying intensity throughout this spectrum is studied by comparing it with that due to a black body, using suitable diaphragms. The distribution curve obtained is sinusoidal. A. H.

1238. Continuous Absorption Spectrum of Bromine. N. S. Bayliss. *Roy. Soc., Proc.* 158*A*. *pp*. 551–561, *Feb.* 3, 1937.—The wave mechanical theory of the continuous absorption spectrum of a diatomic molecule is presented in such a way that the calculation of absorption coefficients involves only two arbitrary constants, which determine the potential energy curve of the upper state concerned in the absorption. The theory is compared with the experimental data for Br_2, which has a complex continuum consisting of two well-marked components. The potential energy curve calculated for the upper state of the long wave-length component ($\lambda_{max.} = 4950$ Å) agrees well with the Morse curve of the $^3\Pi_{0+u}$ state of Br_2; while that of the short wave-length major component ($\lambda_{max.} = 4150$ Å) lies some 3000 wave numbers above. An empirical relation is discussed, which enables one to determine rapidly the course of the potential energy curve of the upper state of a continuous absorption from a knowledge of the absorption coefficients and the spectroscopic constants of the ground state. AUTHOR.

1239. Zeeman Effect of the Cadmium Lines $5^3P_{0,1,2}$–6^3S_1. S. Sato. *Tohoku Univ., Sci. Reports*, 25. *pp*. 686–712, *Dec.*, 1936. *In English.*—In this paper, the observed results of the Zeeman effect of the Cd line $^3P_{0,1,2}$–$^3S_1$ in a magnetic field of varying intensities are reported, and it is proved that these results are in good agreement with those which may be deduced from Goudsmit and Bacher's formula. AUTHOR.

1240. Zeeman Effect in the Arc Spectrum of Nickel. H. Dijkstra. *Physica*, 4. *pp*. 81–103, *Feb.*, 1937. *In English.*—The Zeeman effect in the arc spectrum of Ni is investigated. As a light-source a vacuum arc with cooled electrodes of a very compact construction is employed. Of the 140 lines measured, about 50 were resolved. For a few configurations the *g*-sum-rule appeared to be invalid, which must be ascribed to a mutual interaction. For the configuration d^94p this appears to be in accordance with a deviation from the rule of Harrison and Johnson investigated by van Driel. A method is described for intensity measurements on the Zeeman effect without photographing special density marks. The intensity ratios in the Zeeman patterns appear to agree with the theoretical values. A few measurements on unresolved patterns were carried out with the aid of a density curve, giving an accuracy of about 1 %. In one case a perturbation of the intensities in the Zeeman effect is observed, owing to the small distance of two levels belonging to different configurations. AUTHOR.

1241. Raman Effect in Heterocyclic Six-Membered Rings. L. Kahovec and K. W. F. Kohlrausch. *Zeits. f. phys. Chem.* 35. *Abt.B.* 1. *pp*. 29–41, 1937.—The Raman spectra of pentamethylene oxide, α-trioxymethylene, paraldehyde, and piperazine are reported and the spectral transitions cyclohexane (D_{3d}) → pentamethylene oxide (C_s) → dioxan (C_{2h}) → α-trioxymethylene (C_{3v}) are discussed and the active frequencies for the rings are assigned. W. R. A.

1242. Analysis of the Raman Spectra of $Si_2Cl_6(l)$ and of $Si_2H_6(g)$. F. Stitt and D. M. Yost. *J. Chem. Phys.* 5. *pp*. 90–96, *Feb.*, 1937.—The Raman spectra of $Si_2H_6(g)$ and of $Si_2Cl_6(l)$ have been photographed. Polarisation measurements of the stronger lines of Si_2Cl_6 have been made. From a consideration of the relations among the modes of vibration of similar molecules having different symmetry, the analysis of the observed lines is facilitated by a knowledge of the assignments of the fundamental frequencies of SiH_4, $HSiCl_3$ and $BrSiCl_3$. A definite assignment is made for the three observed lines of Si_2H_6. A tentative assignment of the observed lines of Si_2Cl_6 is made and some evidence is presented for the existence of internal rotation in this molecule at room-temperature. AUTHORS.

1243. Attempt to Observe the Spectrum of Doubly Excited Helium. A. T. Kiang, S. T. Ma and Ta-You Wu. *Chinese J. of Physics*, 2. *pp.* 117–123, *Dec.*, 1936. *In English.*—An attempt to observe the spectrum of doubly excited He by excitation by electron impact, with energies between 300–600 eV, is made without success. This and other failures are discussed by considering the life-times of the doubly excited states. An approximate calculation gives for $2s3s\,^3S$ a life-time of the order 10^{-15} sec., corresponding to a natural width of the level of the order 1000 cm^{-1}. While this accounts for the absence of a line spectrum of doubly excited He, it renders the former suggestion that the corona lines may be due to it untenable. AUTHORS.

1244. Sorting of Alloy Steels by the Steeloscope Method. L. Iwanzow and S. Mandelstam. *Techn. Phys., U.S.S.R.* 3. 11. *pp.* 987–996, 1936. *In German.*—Conditions for accurate estimation of Cr, V, Mn, Co, W, Mo, Ni are critically discussed. Motor-car steels can be divided into nine groups and the exact composition obtained subsequently with rapidity by examination of a separate group of lines for each element. Special attention is paid to Cr, in view of its universality in alloy steels. Schliessman's method of semi-quantitative analysis developed at Krupp's is critically examined, and in general confirmed, apart from the sensitivity of Cr and Ni estimation. Carbonyl iron is recommended for electrodes in place of carbon. D. R. H.

See also Abstracts 958, 1008, 1177, 1313, 1321, 1352, 1372.

VISION.

1245. Law for Minimal Discrimination of Intensities. Part I. W. J. Crozier and A. H. Holway. *Nat. Acad. Sci., Proc.* 23, *pp.* 23–28, *Jan.*, 1937.—Sensory discrimination of two just recognisably different intensities I_1 and I_2 is governed by the fact that the just discriminable ΔI is directly proportional to, and determined by, σ_{I_2}. The properties of the data of sensory discrimination arise from the essentially statistical (*i.e.*, probability) character of the basis for comparison between the effects due to I_1 and the variable capacity of the organism to give a statistically distinguishable effect under the action of a compared I_2. The governance of ΔI by σ_{I_2} is independent of any specific properties of a particular peripheral or central sensory mechanism. AUTHORS.

See also Abstract 1085.

X-RAYS.

1246. Scattering of X-Rays. G. Thomer. *Phys. Zeits.* 38. *pp.* 48–57, *Jan.* 15, 1937.—An investigation has been carried out into the angular distribution of X-rays scattered from various Ne-like substances; namely Ne, H_2O, NH_3 and CH_4. The $K\alpha$-radiation of Cu was used. The experimental procedure, with the necessary precautions and corrections, is carefully detailed. The results are given by plotting $(\sin\frac{1}{2}\theta)/\lambda$ against the intensity. A lengthy comparison with theory is made, in which the screening constant, *s*, as applied to the Hartree method of calculation, is defined. Various values of this constant, which is characteristic of the field, are employed in the theoretical calculations to obtain the best agreement with experiment. The results indicate that the scattering of X-rays can be described by a centrally-symmetric Ne-like model. Finally the results are applied to the case of the scattering of X-rays by C_6H_6. Good agreement is obtained. G. O. B.

* **1247. Tri-Electrode Ionisation Chamber for X-Ray Absorption Coefficients. G. A. Wrenshall and E. L. Harrington.** *Canad. J. of Research*, **14.** *Sect. A. pp.* **209–215,** *Dec.*, **1936.**—A balance method of measuring absorption coefficients for X-rays in absorbing media, using a new form of sectored disc for determining alterations in intensity and an ionisation chamber containing three electrodes, has been developed. The new arrangement makes possible a simplification of the apparatus, a complete elimination of certain sources of error, and very direct calculations of the results. A curve is included in this report to indicate the accuracy routinely attainable. AUTHORS.

1248. Photochemical Reduction with X-Rays and Effects of Addition Agents. G. L. Clark and W. S. Coe. *J. Chem. Phys.* **5.** *pp.* **97–105,** *Feb.*, **1937.**—The rate of photochemical reduction of ceric sulphate, by " white " radiation of effective wave-length about 0·6Å, is virtually independent of the concentration and of the dosage. It is retarded by additions of $AgNO_3$ and $AgClO_4$, is unaffected by $NaNO_3$, $NaClO_4$ and Na_2SO_4 and is accelerated by $Hg(NO_3)_2$, HNO_3, $HClO_4$ and a number of organic materials of varied type. Similar results were obtained in the reduction of $KMnO_4$ but the reaction-product depended on the acidity of the solution: KIO_4 is also reduced, but not $KBrO_4$; in both cases H_2O_2 is formed. Two independent methods are given for estimating (*i*) the ions reduced per *r* unit absorbed; (*ii*) *r* units and absorbed calories necessary for reduction of one equivalent, (*iii*) ions reduced per ion pair formed by X-rays, and a mechanism proposed for the observed formation of H_2O_2 on irradiating water containing dissolved O_2. L. V. C.

1249. Effect of Thermal Agitation on Reflection of X-Rays by Crystals. S. Y. Sze. *Chinese J. of Physics*, **2.** *pp.* **124–127,** *Dec.*, **1936.** *In English.*—A simplified wave-mechanical method of deriving the temperature factor in the reflection of X-rays from crystals is given. The general expression for the function M is the same as calculated by Zener and Jauncey. Hence the discrepancy between Zener's theory for hexagonal crystals and the experiments may be due to the special model used in his calculation. AUTHOR.

1250. Intensities of X-Ray Reflections from Bismuth Crystals between 25° and 530° Abs. A. Goetz and R. B. Jacobs. *Phys. Rev.* **51.** *pp.* **151–159,** *Feb.* **1, 1937.**—The object of this investigation is to throw light on a reported decrystallisation process below the melting point, to check the Debye-Waller relation, to test the validity of theory when extended to anisotropic systems, and to examine reported discontinuities attributed to pseudo-allotropic changes in Bi crystals. Full data for temperature variation of the integrated intensities J_T/J_N of reflections of $MoK\alpha$ radiation from Bi crystals on (*111*) are reported over a wide range. The ratio J_T/J_N is found to follow the Debye-Waller relation. The calculated characteristic temperatures of Bi are 92·5° and 95·9° Abs., without and with consideration of the zero-point energy, respectively. Measurements support the assumption of the zero-point energy. No indication of a discontinuity of J_T/J_D is found in the region of the pseudo-allotropic transformation point at 75° C., but a deviation from the relation begins 50° to 80° before the melting point. N. M. B.

1251. Index of Refraction of Cerussite for X-Rays. J. E. Field and G. A. Lindsay. *Phys. Rev.* 51. *pp.* 165–169, *Feb.* 1, 1937.—The refractive index of cerussite ($PbCO_3$) is measured for some 14 wave-lengths lying in the spectral regions from 2500 to 3600 X.U. and from 4800 to 5400 X.U. In this neighbourhood are found also the five M absorption limits of lead. On account of the high density (6·6 gm. per cc.) of cerussite, the unit decrement $\delta (= 1 - \mu)$ is much larger than that of such crystals as calcite, quartz, etc. From the theory of dispersion δ/λ^2 should decrease considerably in the vicinity of the absorption limits. A general decrease in the value of δ/λ^2 was found, especially toward the higher wave-lengths, but it is not evident that there is a very large change in the immediate vicinity of an absorption edge. The method used differs somewhat from those previously employed. AUTHORS.

1252. L-Spectrum of Rhenium. Yvette Cauchois. *Comptes Rendus,* 204. *pp.* 255–257, *Jan.* 25, 1937.—In earlier work [see Abstract 4250 (1936)] several long exposures were obtained of the L-spectrum of Re. Various feeble lines on these plates are now measured and the wave-lengths tabulated; when possible the allocations of the lines are also given. A. H.

1253. X-Ray Spark Lines. F. Wisshak. *Ann. d. Physik,* 28. 1. *pp.* 71–86, *Jan.,* 1937.—In this paper, in which considerable attention is paid to previous work on the subject and on conjoint problems and to a discussion of the various factors affecting this branch of X-ray spectroscopy, an investigation is made of the intensity of the lines belonging to the $K\alpha_{34}$ group of Cu. The ionisation method is employed using a double spectrometer. The results are given in graphical form: the ratio of intensity of the group to the intensity of the $K\alpha_{1,2}$ group being plotted against the tube potential. At potentials above 19 kV the ratio is found to be almost constant and to have the value (0·6 ± 0·02) %. From the measurements at potentials below 19 kV the excitation potential of $K\alpha_{34}$ is found to be (11 ± 1·5) kV, a value which is compatible with the assumption of a mutual ionisation of the K and L levels as initial states for $K\alpha_{34}$. G. O. B.

1254. K-Absorption Edge of Cu. T. Dryński. *Acta Physica Polonica,* 4. 4. *pp.* 463–474, 1935. *In French.*—Various discrepancies in previous experimental investigations of the fine structure of the K-absorption edge of several elements have led the author to study the K-edge of the Cu radiation, when the element is in the metallic form and in various chemical combinations. Each of the forms of the element studied, *i.e.* metallic Cu, CuS, Cu_2S, and $CuFeS_2$, belongs to a different crystalline system. Variations in the fine structure of the K-edge of Cu in these different forms are studied spectrographically, and the results obtained are discussed in the light of Kronig's theory. The construction of the crystalline lattice is shown to have an effect on the secondary structure of the absorption edge. G. O. B.

1255. K-Absorption Edge of Cu at Low Temperatures. H. Swedenborg and M. Claesson. *Ann. d. Physik,* 28. 2. *pp.* 159–168, *Jan.,* 1937.—The influence of low temperatures on the fine structure of the K-absorption edge of the Cu Spectrum is investigated using a Siegbahn vacuum spectrograph and a Moll microphotometer to measure the records. A W antikathode is employed in the X-ray rube. The Cu is used in the form of foil of about 7μ thickness. A detailed discussion is given of the conditions necessary for obtaining good records of the fine structure. Special attention is paid to determining the most suitable make of photographic plate and developer. The experimental results show that the fine structure at − 190° C. exhibits several more components than at + 20° C., in agreement with the theory of Kronig. G. O. B.

1256. K-Absorption Spectra of Ni and Cu. T. Hayasi. *Tohoku Univ., Sci. Reports,* 25. *pp.* 598–605, *Nov.,* 1936. *In German.*—The K-absorption spectra of Ni and Cu obtained from alloys of composition 50 % Ni − 50 % Cu and 75 % Ni − 25 % Cu, are compared with the corresponding absorption spectra of the pure metals. The fine-structure of the absorption spectrum from each metal in alloy form resembles exactly that of the spectrum from the pure metal, *i.e.* the magnetic properties of these alloys have no influence on the absorption spectra. J. T.

1257. K-Absorption Spectra of Ni. T. Hayasi. *Tohoku Univ., Sci. Reports,* 25. *pp.* 606–620, *Nov.,* 1936. *In German.*—The absorption edge of Ni in $NiCO_3$ and $Ni(OH)_2$ is single-valued and agrees with the K_2 (short-wave) edge of pure Ni. In the intermetallic compounds NiAl and NiSn the single absorption edge agrees with the K_1 (long-wave) edge of pure Ni. In Ni_2O_3 two values are obtained which are, however, different from those of pure Ni. Since the fine-structure in the immediate neighbourhood of the principal edge differs in different compounds it is concluded that the energies of the outer electrons are different for different states of aggregation. The fine-structure is similar in $NiCO_3$, $Ni(OH)_2$, Ni_2O_3 and NiSn, all of which have hexagonal structures. J. T.

1258. L-Absorption Spectrum and the Characteristic Levels of Mercury. Yvette Cauchois. *Comptes Rendus,* 204. *pp.* 122–125, *Jan.* 11, 1937.—In continuation of a previous investigation of the L-spectrum of Hg [see Abstract 2611 (1935)], the L-absorption spectrum is studied. The mercury is employed in the form of HgO, $HgCl_2$ and the element in the solid and liquid states. No systematic difference in the positions of the L-discontinuities is observed. The frequencies of the edges are measured and employing the emission frequencies already published the values of the characteristic levels are calculated. C. J. B. C.

1259. X-Ray Diffraction with Single-Crystal Source. G. Borrmann. *Ann. d. Physik,* 27. 8. *pp.* 669–693, *Dec.,* 1936.—The diffraction effects produced by using a single crystal as a source of X-rays are studied. In the present work the X-rays are excited by a primary beam of X-rays and not by an electron stream as has previously been the case. Light and dark lines, similar to those obtained with electron-excited X-rays, are obtained on the photograph but are superimposed on an ordinary Laue pattern. The differences between the diffraction effects now observed and those previously obtained may be attributed to the greater depth in the crystal at which the X-rays are generated in the present case. J. T.

1260. Fine-Structure of Diffraction Lines from Single Crystal Antikathode. H. Voges. *Ann. d. Physik,* 27. 8. *pp.* 694–720, *Dec.,* 1936.—By the aid of a photometric method it is shown that the diffraction lines observed when a single crystal of Cu is used as an antikathode exhibit a fine structure. Light, dark, and light-dark lines are considered and some of the observed results are explained theoretically. J. T.

1261. X-Ray Diffraction and Electrolytic Dissociation. Part I. Sulphuric Acid and Sulphates. R. S. Krishnan. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 661–666, *Dec.,* 1936.—X-ray diffraction of the aqueous solutions of H_2SO_4, bisulphates and sulphates has been studied. 100 % H_2SO_4 gives only one sharp intense maximum with very little scattering on either side. On dilution with water the ring becomes broader and more diffuse. 50 % solution of the acid gives only a bright corona surrounding the central spot, the diameter of the edge of the corona corresponding to that of the water ring. With further dilutions the halo again appears, the maximum of which coincides with that of water in very dilute solutions. 34 % $KHSO_4$ and 30 % H_2SO_4 give identical diffraction patterns. Dilute solutions of H_2SO_4 and $KHSO_4$ and solutions of the sulphates also give similar patterns. It has been pointed out that step-wise dissociation of H_2SO_4 and bisulphates is responsible for the observed diffraction patterns. An attempt has been made to correlate the results obtained by X-ray diffraction experiment with those obtained from the Raman effect.

AUTHOR.

***1262. Efficiency of an Aluminium Counting Tube for X-Ray Measurements. P. Weber.** *Helv. Phys. Acta,* 10. 1. *pp.* 32–46, 1937. *In German.*—The absolute efficiency of a counting tube is defined as $A = N/N_0$, where N is the number of counts registered in unit time and N_0 is the number of quanta reaching the effective layer of the counter in that time. Apparatus is described in which X-rays from a Mo antikathode are reflected from a calcite crystal and pass successively through a counting tube and an argon-filled ionisation chamber. The number of effective quanta is calculated from the measured ionisation current assuming an energy of 29·6 eV per ion pair in A. The values of the efficiency are given to 0·5 %. The experimental results agree well with the theory put forward, if allowance is made for the thin oxide coating on the Al. It is pointed out that this coating considerably reduces the efficiency of the counter. The decrease in counting efficiency with increasing radiation intensity, owing to the limiting resolving power of the counting tube and mechanism, is again in good agreement with theory. At high radiation intensities the efficiency has only about half its original value. J. E. R.

See also Abstracts 1009, 1014, 1277.

HEAT.

CALORIMETRY.

***1263. Specific Heats of Concentrated Aqueous Solutions of Salts. J. d'Ans and H. Tollert.** *Zeits. f. Elektrochem.* 43. *pp.* 81–91, *Feb.*, 1937.—An air thermostat is described in which the liquid is stirred by a rotatory movement of the internal portions of the apparatus. The specific heats of NaCl, KCl, K_2SO_4, $MgCl_2$, $MgSO_4$, $NaNO_3$, KNO_3, NH_4Cl, NH_4NO_3, are measured at 21° C. up to the point of saturation, and at 41° and 86° only at the point of saturation. The mean specific heat of the solid salts $Na_2CO_3.10H_2O$ and $Na_2SO_4.10H_2O$ are measured between the temperatures of 3° and 19° C. The results are discussed. **Erratum,** *ibid. p.* 201, *March*, 1937. F. J. B.

1264. Specific Heat of Paramagnetic Crystals at Low Temperatures. I. Waller. *Zeits. f. Physik*, 104. 1–2. *pp.* 132–134, 1936.—A formula for the contribution of magnetic effect energy towards specific heat is derived and numerical values for $Fe(NH_4)(SO_4)_2 + 12\ H_2O$ and $(Gd)_2(SO_4)_3 + 8\ H_2O$ are considered. W. R. A.

1265. Specific Heat of Iodine. L. G. Carpenter and T. F. Harle. *Phil. Mag.* 23. *pp.* 193–208, *Feb.*, 1937.—The paper records the true specific heat of iodine from 202° to 433° K., a range of temperature which includes the melting point (387·1° K.). Measurements are also made of the mean specific heat from 100° to 20° C. From the experimental values of C_p for the solid, the corresponding values of C_v are deduced, and it is found that it does not exceed 3 R cal./gm. atom even in the immediate neighbourhood of the melting point, and that there is some evidence of a slight maximum at about 250° K., thus showing an effect found by Eucken and Dannöhl [see Abstract 5141 (1934)] in NaCl and Ag. C_p in the liquid was found to be about 10 cal./gm. atom, but an estimate of the lower limit of C_p-C_v showed that C_v cannot exceed 3 R by much, if at all. L. G. C.

1266. Heats of Fusion of Inorganic Substances. K. K. Kelley. *Bureau of Mines, Bull. No.* 393. [166 *pp.*], 1936.

See also Abstracts 957, 1115, 1280, 1292, 1294, 1295, 1297.

CONDUCTION.

1267. Energy Exchange of He, Ne and A Atoms with a Metal Surface. G. Zacharjin and G. Spiwak. *Phys. Zeits. d. Sowjetunion*, 10. 4. *pp.* 495–509, 1936. *In German.*—No complete balance is found between the energy of the atoms of an attenuated gas flowing towards the walls and those of the surface, but theory and experiment are used to find the accommodation coefficient both for pure W surfaces and those covered partially or wholly with films of N_2, O_2 and H_2. From the temperature graph of the accommodation coefficient, the surface share θ can be ascertained for the metal. Keeping the temperature of the pure metal constant at 400° K. and changing that of the inert gas from 80° to 373° K., the dependence of the coefficient for He and A is found to agree with Landau's theoretical prediction. The "mass relation," *i.e.*, the effect of the ratio of the atomic mass of W and the mass of the adsorbed gas particles is discussed and the limits of its usefulness given. H. M. B.

1268. Thermal Conductivity of Unsaturated Gaseous Hydrocarbons at Low Pressures. R. Delaplace. *Comptes Rendus*, **204.** *pp*. 263–265, *Jan*. 25, 1937.—In the same way [see Abstract 755 (1937)] the conductivities of C_2H_4, C_3H_6, normal- and iso-C_4H_8, cyclopropane, and C_2H_2 were determined and compared with that of H_2. As for the saturated hydrocarbons the conductivity is independent of pressure if this is > 200 baryes, and of composition if pressure exceeds 150 baryes (except that that of H_2 is substantially greater for the higher pressures). Below 150 (*e.g.*, at 50) baryes the order of increasing conductivity is H_2, C_2H_4, C_2H_2, cyclopropane, C_3H_6, iso-C_4H_8, normal-C_4H_8. C. A. S.

1269. Absolute Measurement of the Thermal Conductivity of Gases. W. Nothdurft. *Ann. d. Physik*, **28.** 2. *pp*. 137–158, *Jan*., 1937.—The Schleiermacher hot wire method is used to determine the thermal conductivity of gases. Several experiments are carried out, wires ranging from 23 to 52 μ being heated within glass tubes of 8 and 14 mm. dia. and copper tubes of 16 and 1 mm. dia. After full corrections have been applied the following values are obtained for the thermal conductivity at 0° C., for 0_2 $(588 \cdot 9 \pm 0 \cdot 4) \times 10^{-7}$; for dry CO_2 free air $(577 \cdot 7 \pm 1 \cdot 2) \times 10^{-7}$; for H_2 $(424 \cdot 5 \pm 2 \cdot 9) \times 10^{-6}$; and for D_2 $(303 \cdot 3 \pm 1 \cdot 1) \times 10^{-6}$ cal./cm. sec. °C. This value for D_2 is 1·03 % greater than that indicated by theory, according to which the ratio of the conductivity of H_2 at 0° C. to that of D_2 is 1·414. R. W. P.

1270. Determination of Thermal Diffusivities. C. Starr. *Rev. Sci. Instruments*, **8.** *pp*. 61–64, *Feb*., 1937.—The dynamic method of determining thermal diffusivities devised by King [see Abstract 339 (1916)] has been improved. A sinusoidal temperature is impressed on one end of a wire specimen, and the thermal diffusivity is determined from the measured decrement of the temperature wave travelling along the specimen. Elimination or determination of heat losses in unnecessary. Greater precision is possible with this method than with previous methods. The thermal diffusivity of a pure specimen of Ni, measured at 25° C., was 0·15885 cm^2./sec., with a probable error of 0·06 %. The thermal conductivity of Ni corresponding to this determination is 0·618 W /cm. °C. AUTHOR.

See also Abstracts **952, 1292.**

CONVECTION.

1271. Convection and Variation of Temperature near a Hot Surface. Part II. M. K. Paranjpe. *Indian Acad. Sci., Proc.* **4A.** *pp*. 639–651, *Dec*., 1936.—The paper describes an interferometric method of measuring the temperature distribution near hot surfaces. The details of the method and the various precautions to be taken are discussed. The distribution of temperature in the case of a horizontal air cell between a hot surface above and a cold surface below is discussed in relation to convection and the importance of using small air gaps (2 mm. or less) in thermal conductivity measurements is pointed out. Pictures of the interference pattern when the air cell is 1·61 mm. and 0·77 mm. thick are given along with the temperature distribution calculated from these pictures. [For Part I see Abstract 278 (1937).] AUTHOR.

1272. Vortices in Longitudinal Bands. D. Avsec. *Comptes Rendus*, **203.** *pp*. 1318–1320, *Dec*. 14, 1936.—A layer can divide itself into any number of double vortices. Each of these formations is stable, but they have not the same degree of stability. It is probable that the formation of the most stable systems will be the most frequent. [See Abstracts 4773 and 5191 (1936) and following Abstract.] W. A. R.

1273. Vortices in Longitudinal Bands. D. Avsec. *Comptes Rendus*, 204. *pp.* 167–169, *Jan.* 18, 1937.—Two types of thermo-convective vortices are known, polygonal cellular vortices (Bénard) and longitudinal bands (Idrac-Rayleigh). The causes for lateral bands of wave form are (1) a considerable increase of the temperature difference of the two faces of the fluid layer divided previously into rectilinear bands, and (2) an acceleration or retardation of the general movement of the fluid layer inside which the vortices form. When the general air motion is uniform and moderate temperature differences exist between the faces, rectilinear bands of vortices form but with increase of temperature difference, the internal motion is more active, sinusoidal wave bands form, and the amplitude of oscillation increases. Photographs illustrate such wave forms. The motion is similar to that found by Taylor with a fluid between two rotating cylinders. [See Abstract 551 (1934) and preceding Abstract.] R. S. R.

1274. Theory of Heat Interchange and Resistance for Gas Flow at High Velocities. M. Schirokow. *Techn. Phys., U.S.S.R.* 3. 11. *pp.* 956–972, 1936. *In German.*—Commencing from the Kármán theory for turbulent heat interchange and the generalised equation for gaseous flow, it is shown that a differential equation can be obtained to represent the heat transfer for high velocity flow in a cylindrical tube, which is of the same form as that obtained by Latzko for flow at normal velocities, but in which the temperature is the *bremsungs* temperature given by $T = \theta + Av^2/2C_p$, where θ is the mean gas temperature, A the mechanical equivalent of heat, v the mean gas velocity and C_p the specific heat at constant pressure. For an incompressible gas this equation leads to the following relation between the Nusselt (Nu) and Peclet (Pe) numbers, $Nu = 0{\cdot}971 \ldots [\theta + (64/63)\ (Av^2/2C_p)]\ \theta^{-1}\ (\xi/8)$ Pe, where ξ is the resistance coefficient. This equation is in good agreement with the measurements of Guchmann, Iljuchin, Tarassowa and Warschawski [see Abstract 1744 (1936)]. By assuming the Kármán velocity distribution to apply in a given cross-section of the tube, and a varying maximum velocity along the length, it is shown that the compressibility of the gas exerts no great influence and, therefore, the results obtained apply to normal gases. R. W. P.

See also Abstract 1112.

DILATATION.

1275. Apparent Volumes and Thermal Expansions of Salts in Aqueous Solution. R. E. Gibson and J. F. Kincaid. *Am. Chem. Soc., J.* 59. *pp.* 25–32, *Jan.*, 1937.—We have measured the thermal expansions from 20 to 40° of aqueous solutions of barium chloride, potassium bromide, potassium nitrate, sodium iodide and lithium bromide over the entire range of concentration and also the specific volumes at 25° of the solutions of the three last-named salts. From these results apparent volumes, apparent expansions and apparent expansibilities were computed and where possible expressed analytically by simple formulæ as functions of temperature and concentration. We have suggested a new concentration variable which sometimes replaces c_2 to advantage in the square root formulæ. It seems from our results that the linear relation between apparent expansibilities and the square root of the concentration is fortuitous and not to be expected in general, the complete curve being sigmoid. We find no evidence requiring breaks in the curves of the apparent volumes or the apparent expansions of lithium bromide against the concentration at atmospheric pressure. AUTHORS.

1276. Negative Expansion Coefficient of Silver Iodide. E. Cohen and H. L. Bredée. *Zeits. f. phys. Chem.* 178. *Abt.A.* 3. *pp.* 184–186, 1937.—Jones and Jelen recently obtained the value $-1 \cdot 6 \times 10^{-6}$ for the coefficient of cubical expansion of α-AgI between 20 and 60° C. It is here pointed out that the mode of preparation adopted by these workers is such as to give a mixture of the α and β modifications, so that the value they obtained is erroneous. There appears to be no reason to doubt the value $-4 \cdot 1 \times 10^{-6}$ originally determined by Fizeau. L. A. W.

1277. Thermal Expansion of the Bi Lattice. R. B. Jacobs and A. Goetz. *Phys. Rev.* 51. *pp.* 159–164, *Feb.* 1, 1937.—The thermal expansion of the lattice of Bi crystals between 25° and 530° Abs. is measured with a Bragg spectrometer equipped with a movable slit between crystal and ionisation chamber. The 2d, 3d and 5th orders of Mo $K\alpha$ reflections on (111) were used, α_{11} thus obtained varies from $8 \cdot 3 \times 10^{-6}$ to $17 \cdot 4 \times 10^{-6}$ at 25° Abs. and 120° Abs., respectively, beyond the latter temperature it stays unchanged until the melting point. Only the range between − 15° C. and + 75° C. forms an exception where the expansion coefficient drops to $13 \cdot 8 \times 10^{-6}$. This seems to indicate the existence of a separate "phase," not characterised by a change of the lattice configuration and confirms certain previous findings of discontinuities at + 75°. A definite divergence between the lattice and the integral expansion beginning 30° before the melting point was found. The Grüneisen rule (a/c_p = const) is found to hold in first approximation for the whole temperature range. The relation of the α_{11} values obtained to those of other authors is discussed. AUTHORS.

See also Abstract 1283.

MELTING AND BOILING POINTS.

1278. Melting Points of Aliphatic Chain Compounds. P. Carré and H. Passedouet. *Comptes Rendus*, 204. *pp.* 347–349, *Feb.* 1, 1937.—The melting points of the members of many series of aliphatic substances are well-known to alternate with the number of C atoms which the substance contains. In this paper the urethanes, corresponding to the primary normal alcohols C_1 to C_{18}, have been studied. An alternation is found for members from C_1 to C_4, from C_7 to C_8 and from C_{12} to C_{18}. No alternation is found between C_4 and C_7 and between C_8 and C_{12}. Speculations are made concerning the relation between the alternation of the melting points and the polarity of the terminal C atom. G. G.

1279. Melting Points and Crystal Spacing of *n*-Fatty Acids and Derivatives. F. Francis, F. J. E. Collins and S. H. Piper. *Roy. Soc., Proc.* 158*A*. *pp.* 691–718, *Feb.* 3, 1937.—The melting points and crystal spacings have been determined (or redetermined) for several of the C_{2n} acids with C_{14}–C_{26}, for all between C_{28} and C_{38}, and for C_{46}, showing these constants, when plotted against C content, all to lie on smooth curves (melting points) or straight lines (spacings). Crystals of acids from solution in acetic acid show only C spacings, those from non-polar solvents B spacings. The C spacings of mixtures of palmitic and stearic acids were examined and the accuracy with which the composition of mixtures can be deduced therefrom discussed. Results imply the existence of an equimolecular compound of the two acids, which forms eutectics with both palmitic and stearic acids melting at 55·5° and 58·4° and containing 31·38 and 53·8 % stearic acid respectively. C. A. S.

1280. Transformations in the System SO_3. Part II. A. Smits and N. F. Moerman. *Zeits. f. phys. Chem.* 35. *Abt.B.* 1. *pp.* 69–81, 1937.—The transformations and equilibrium conditions for the β-form of SO_3 are investigated. The triple point is found to be at 31·5° C. and a pressure of 375·5 mm. Hg. The so-called colloidal form of SO_3 appears to be nothing more than liquid SO_3 containing a small quantity of fibres of the α-form. The heat of sublimation is 13·5 k.cal./mol., the heat of evaporation is 10·6 k.cal./mol., and the heat of fusion is 2·9 k.cal./mol. Heats of solution of the β-form of SO_3 in concentrated H_2SO_4 are also measured. The structure of the polymerised molecules is also discussed. [See also Abstract 2987 (1936).] G. G.

1281. Latent Energy of Solid Solutions. J. Cichocki. *Comptes Rendus*, 204. *pp.* 233–234, *Jan.* 25, 1937.—For the metals Zn–As, Cd–Sb, Hg–Bi, dissolved in Cu, Ag or Au, Linde finds that the increase in electrical resistivity is given by $\Delta\rho = a + bz^2$, a and b being constants and z the difference between the valencies of solute and solvent. Mott explains this theoretically by assuming that the stronger atoms act as origins of electronic waves of intensity proportional to z^2, according to Rutherford's law. By a Thomas-Fermi method the value of electrostatic potential at distance r is found to be $\phi = zee^{-qr}/r$, q being a constant dependent on the density of free electrons in the solvent. [See Abstract 2835 (1936).] Mott's equation may also be interpreted by assuming that the dissolved atom occupies a polyhedron such that its influence outside the atomic volume is negligible. For ease of calculation the Wigner-Seitz polyhedron is replaced by a sphere. Outside V, the electrostatic potential can satisfy the equation if the surrounding solvent atoms are compressed, and if one obtains a positive charge density dependent on the same equation, on condition that the negative charge of the free electrons is uniform throughout the metal, apart from V. By substituting in Poisson's equation the value of ϕ determined as above, the density of the positive charge at r can be found. This is connected with volume by a simple relation so that the diminution of atomic volume of the *solvent* metal at this distance may be determined. V for the dissolved atom is then equal to its volume in the lattice *plus* the sum of the diminutions of volume set up in the solvent atoms surrounding it, and is less than the volume of the atom in its own lattice. Latent energy and work of compression are compared. For Al dissolved in Cu the value is 0·24 eV for a substituted position and 0·44 eV an interstitial position, the corresponding temperatures being 900° C. and 1700° C. On the assumption of a substituted lattice, a freezing point depression of 9° per 1 % Al is calculated, and for small Al concentrations agrees well with the observed solidus of the Cu–Al system. D. R. H.

1282. Separation of Constant-Boiling Mixtures of Naphthene and Paraffin Hydrocarbons by Distillation with Acetic Acid. S. T. Schicktanz. *Bureau of Standards, J. of Research*, 18. *pp.* 129–136, *Feb.*, 1937.—Constant-boiling fractions of gasoline normally boiling in the temperature range 130 to 174° C. and consisting of naphthene and paraffin hydrocarbons, have been successfully separated by distilling with acetic acid. The azeotropic mixtures formed by the hydrocarbons and the acid aid in separately concentrating the paraffin and naphthene groups, which although never absolutely pure, can be separated further by other physical methods. **Author.**

See also Abstracts 952, 1126, 1292.

TEMPERATURE, MEASUREMENT OF.

***1283. Mechanical and Thermal Instruments. J. H. Awbery.** *Journ. Sci. Instruments,* 14. *pp.* 61–64, *Feb.,* 1937.—This article is a description of the apparatus coming under the above headings, which was exhibited at the recent Physical Society's Exhibition. Many instruments are mentioned, amongst the most outstanding being an elastic varnish which does not crack on bending; a new and cheaper planimeter; various dilatometers; a "mercury" thermometer reading to − 60° C., containing an alloy of low freezing point, and very similar to mercury, etc. There is very little description of any of the exhibits, the space only allowing a slightly "amplified catalogue" type of paper. E. H. D.

***1284. Low-Temperature Thermometry. W. H. Keesom.** *K. Onnes Lab. Leiden, Comm. Nos.* 241–252. *Suppt. No.* 80*a. pp.* 1–18, 1936.—The relation between the Centigrade and the Centigrade-Avogadro scales is given, and the author goes on to discuss the behaviour of Pt thermometers over the range 0° to −190° C., and mentions the need for investigation into the effect of impurities on the temperature indications. This is continued for temperatures in the range − 190° to −259° C., and formulæ are given for the temperatures of liquid He. Thermometers of other materials are considered, and results are given of experiments on the variation of resistance with temperature, in this region, for phosphor bronze, Ce, Mg, with and without the presence of a magnetic field, in the case of the phosphor bronze. In a further section temperatures below 1° K. are considered under the headings: He thermometer, phosphor bronze thermometer, adiabatic demagnetisation, and the effect of low temperature on crystal structure. E. H. D.

See also Abstracts 1113, 1290.

THERMOCHEMISTRY.

1285. Integral Heats of Solution of NaCl in D_2O–H_2O Mixtures. E. Lange and W. Martin. *Zeits. f. phys. Chem.* 178. *Abt.A.* 3. *pp.* 214–220, 1937.—Integral heats of solution, L, of 16 alkali halides in 98·4 % D_2O have already been given [see Abstract 4785 (1936)]. It is now shown that with NaCl, at a constant final concentration of 0·45 mol. NaCl/100 mol. water, L (at 25° C.) is a linear function of D content, the limiting values being $L_{H_2O} = -1{\cdot}019$ k.cal. and $L_{D_2O} = -1{\cdot}577$ k.cal. The former results can therefore be extrapolated to 100 % D_2O. Moreover, in considering ionic hydration, the HDO molecule which is present in equilibrium with H_2O and D_2O lies midway between these latter as regards the energetics of hydration. L. V. C.

1286. Heats of Combustion of Hydrocarbons. R. S. Jessup. *Bureau of Standards, J. of Research,* 18. *pp.* 115–128, *Feb.,* 1937.—The measurements were made by means of a bomb calorimeter, which was calibrated electrically for some of the measurements, and by burning standard sample benzoic acid for the remainder. The samples of liquid were inclosed in thin-walled glass bulbs which were flattened on opposite sides, and were ignited by an electric fuse of iron wire. No combustible material other than the iron wire was required to ignite the liquids. Combustible impurities and CO_2 were removed from the O_2 before admitting it to the bomb. Measurements of CO_2 and CO formed in the combustion indicated that the liquids contained very little inert impurity, and that combustion was very nearly complete. The Washburn correction was applied to the results of the calorimetric measurements. The empirical equation $-\Delta H_{25°C} = 259 \cdot 28 + 648 \cdot 84n + 0 \cdot 2587n^2$ where $-\Delta H_{25°C}$ is the heat of combustion in international kj./mol. of liquid normal C_nH_{2n+2} in gaseous O_2 at 25° C. and under a constant pressure of 1 atmos., the products of combustion being gaseous CO_2 and liquid water, also at 25° C., reproduces the mean values within 0·02 %. The final experimental values are estimated to be accurate within 0·03 or 0·04 %. AUTHOR.

1287. Heats of Formation of Silver Chloride, Silver Bromide and Silver Iodide. A. Bertram and W. A. Roth. *Zeits. f. phys. Chem.* 178. *Abt.A.* 3. *pp.* 227–238, 1937.—It is pointed out that the heats of formation of AgCl, AgBr and AgI enter into many thermodynamical calculations and that the recorded values in the literature vary greatly. Mostly they have been indirectly determined. According to the present work the salts are synthesised in a calorimeter from their elements, using Cl_2 and Br_2 with finely divided Ag, while AgI is prepared from Ag powder and KI_3 solution, the heat of removal of I_2 from its solution being determined separately. J. K.

1288. Combustion of Gases. W. F. Kopitow. *Acta Physicochimica*, 5. 6. *pp.* 813–818, 1936. *In German.*—Experiments were carried out to test the actual distribution of temperature in the flame front of a burning gas. In view of the speed of propagation of the flame, special methods had to be used, and two such are described. It is found that in a burning mixture of illuminating gas and air, the heating up to the ignition temperature takes place in a layer of about 1 mm. thickness in front of the flame. A connection is traced between the temperature at various points in the burning gas and the chemical composition there, expressed in terms of O_2 consumed and CO_2 produced. The temperature distribution is found to satisfy the formula of Mallard and le-Chatelier. G. G.

1289. Influence of Velocity of Detonation of an Explosive on Velocity of Shock Wave. P. Laffitte and A. Parisot. *Comptes Rendus*, 204. *pp.* 179–181, *Jan.* 18, 1937.—The velocity of detonation (*a*) and the initial velocity (*b*) of the shock wave in air inside a glass tube and beyond the column of explosive for picric acid, hexogen, penthrite and dynamite No. 1 were plotted against density of loading (Δ), and for mixtures of ammonium nitrate with hexogen or penthrite ($\Delta = 1$) against composition. The results indicate that (*a*) and (*b*) are related both increasing and decreasing more or less together, though neither proportionately nor strictly simultaneously. [See Abstract 3105 (1935).] C. A. S.

1290. Temperature of Open Flames. W. T. David. *Phil. Mag.* 23. *pp.* 251–256, *Feb.*, 1937.—Temperatures of CO–air mixtures, determined by the author by platinum thermometry, using a wire 0·0005 in. in dia., are compared with those calculated, and with those determined by Ellis and Morgan, by Loomis and Perrott, and by Griffiths and Awbery using the sodium-line reversal method. Temperatures measured by the former method vary with variation of mixture strength by about 400° C.; temperatures measured by the sodium-line reversal method show very little variation with mixture strength. This latter method therefore does not provide a means of measuring the true flame temperature. Temperatures of flames, determined by platinum thermometry, may be about 400° C. below the calculated values, but even so, may, owing to the presence of metastable atoms, be over-estimates of true temperatures. J. S. G. T.

See also Abstracts 996, 1301.

THERMODYNAMICS.

1291. Thermodynamic and Kinetic Observations on the Vapour-Pressure Lowering of Solutions. K. F. Herzfeld. *Phys. Zeits.* 38. *pp.* 58–64, *Jan.* 15, 1937.—Thermodynamic and kinetic theory is applied to explain the effect of pressure on the vapour pressure of a liquid, the mechanism of osmotic pressure and the lowering of the vapour pressure of solutions. It is shown that the considerations of Fredenhagen rest on conclusions which are partially unsound. [See Abstract 2379 (1935).] R. W. P.

1292. λ Phenomena of Helium. W. H. Keesom. *K. Onnes. Lab. Leiden, Comm. Nos.* 241–252, *Suppt. No.* 80*b*. *pp.* 1–28, 1936.—At a more or less definite temperature different bodies undergo a change of state, one of the characteristics of which is a sudden change in the specific heat. These phenomena are grouped together under the name "λ phenomena." The author examines the results of experiments on the density and specific heat of He at a temperature of 2·19° K. The whole subject is considered in some detail from the point of view of the P, T and thermodynamic diagrams, and apparatus is illustrated for the determination of the specific heat. The results of new experiments on the viscosity and thermal conductivity of liquid He I and II are given, and the quasi-crystalline structure of He II is commented on. A comprehensive Bibliography is appended. E. H. D.

1293. Entropies of Inorganic Substances—1935. K. K. Kelley. *Bureau of Mines, Bull. No.* 394. [55 *pp.*], 1936.

1294. Thermodynamics of Carbonyl Sulphide. J. D. Kemp and W. F. Giauque. *Am. Chem. Soc., J.* 59. *pp.* 79–84, *Jan.*, 1937.—The heat capacity of liquid and solid COS has been determined from 15° K. to the boiling point. The melting point is 134·31° K., the boiling point, 222·87° K. (0° C. = 273·1° K.). The heat of fusion is 1129·8 cal./mol. and the heat of vaporisation at the boiling point, 4423 cal./mol. The vapour pressure of liquid COS has been measured and the data are represented very closely by the equation: liquid COS 161·8 to 223·8° K. $\log_{10}P(\text{int. cm. Hg}) = -(1318{\cdot}260/T) + 10{\cdot}15309 - 0{\cdot}0147784T + 0{\cdot}000018838T^2$. The density of COS gas at 25° C. and 1 atm. is 2·4849 ± 0·0005 gm./l. From the experimental data the entropy of the ideal gas at the boiling point was found to be 52·56 cal./deg./mol. This may be compared with the value 52·66 cal./deg./mol., calculated from electron diffraction measurements and spectroscopic data. The good agreement between the experimental and calculated values of the entropy indicates that the difference in size between the O and S ends of the COS molecule suffices to prevent random orientation of the type found in CO, N_2O and NO at low temperatures. AUTHORS.

1295. Heat Capacity and Entropy of Rhombic and Monoclinic Sulphur. E. D. Eastman and W. C. McGavock. *Am. Chem. Soc., J.* 59. *pp.* 145–151, *Jan.*, 1937.—Measurements of the heat capacity of rhombic and monoclinic S have been made over the temperature range 15–375° K., and from them the entropy of both forms determined. The entropy difference of the two forms obtained from the heat capacities agrees, within the small experimental uncertainty, with that from the heat of transition, as expected from the third law. The heat capacity at constant volume has been calculated for rhombic S, and its variation with temperature compared with the "*n* formula" of Lewis and Gibson. AUTHORS.

1296. Thermodynamic Treatment of Solutions. R. W. Goranson. *J. Chem. Phys.* 5. *pp.* 107–112, *Feb.*, 1937.—The purpose of this paper is to present a consistent thermodynamic treatment of solutions based on activity and activity coefficient. On the basis of the argument presented interrelations of these quantities are obtained for dissociated and undissociated components. Expressions are also derived for the fugacity and activity of a component in a gas mixture. AUTHOR.

1297. Energy of Surface Formation. W. D. Harkins. *J. Chem. Phys.* 5. *pp.* 135–140, *Feb.*, 1937.—The free energy of the edge of a lens of a non-volatile oil on water is found by a consideration of the magnitude of the molecular energy involved to be very small, and of the order of 3×10^{-6} erg/cm. Thus the linear tension of the edge should be of the order of 3×10^{-6} dyne. The smallness of the energy does not indicate a lack of importance of the edge, since the molecular energy is higher than in the surface. Linear energy and the presence of edges are of importance in practically all solids, since these are in general built up of crystal grains, and are of special significance in certain biological systems. Equations which give the relation between the free, latent and "total" energy of the edge and the latent heat of vaporisation are presented. AUTHOR.

1298. Thermodynamics of the Spherical Capillary Layer of Unitary Substances. G. Bakker. *Zeits. f. phys. Chem.* 178. *Abt.A.* 3. *pp.* 193–213, 1937.—The systems studied are the capillary phases at the surface of a bubble or of a drop. A development of the classical Gibbs treatment gives the quantity $(u\text{-T}s + p_{\text{T}}v)$ as the thermodynamic potential of the capillary layer, as it has the same values for the layer and for the enclosing liquid and vapour phases; here u, s and v represent energy, entropy and volume respectively per unit mass, p_{T} is the tangential pressure in the layer and T the absolute temperature. A new derivation is given for a method of construction of the labile part of the isotherm previously given by the author. It is finally shown that the maximum capillary rise of a liquid occurs with a radius of 2·5 mμ, which is of the same order as the estimated pore-radius of silica gel. L. V. C.

1299. Test of Third Law of Thermodynamics by Two Crystalline Forms of Phosphine. C. C. Stephenson and W. F. Giauque. *J. Chem. Phys.* 5. *pp.* 149–158, *Feb.*, 1937.—The heat capacity of solid and liquid PH_3 has been measured from 15° K. to its boiling point, 185·38° K. Transformations occur at 30·29, 49·43, and 88·10° K., the heats of transformation being 19·6, 185·7 and 115·8 cal./mol. respectively. The melting point is 139·35° K. and the heat of fusion 270·4 cal./mol. The heat of vaporisation at the boiling point is 3489 cal./mol. The vapour pressures, P, in int. cm. of Hg are represented by the following: for solid PH_3 128·67 to 139·35° K., $\log_{10}\text{P} = -895{\cdot}700\ \text{T}^{-1} + 6{\cdot}86434$; and for liquid PH_3, 139·35 to 185·56° K., $\log_{10}\text{P} = -1027{\cdot}300\text{T}^{-1} - 0{\cdot}0178530\ \text{T} + 0{\cdot}000029135\ \text{T}^2 + 9{\cdot}73075$. At 49·43° K. the entropy of the solid obtained from calorimetric measurements on the stable form is 8·14, that from similar measurements on the unstable form being 8·13 cal./deg./mol. These measurements provide confirmation of the third law of thermodynamics. The molar entropy of the ideal PH_3 gas at 298·1° K. is 50·35 cal./deg./mol., whereas the value calculated by Yost from spectroscopic data is 50·5. The constants of the PH_3 molecule are derived from the experimental entropy values. R. W. P.

1300. Range of Application of the Nernst Heat Law. H. Schmolke. *Zeits. f. Physik*, 104. 3–4. *pp.* 221–227, 1937.—It is shown that there is frequently insufficient basis for the limitations which are placed on the range of application of the Nernst heat theorem. R. W. P.

1301. Deduction of Reaction Mechanisms from the Theory of Absolute Rates. A. E. Stearn and H. Eyring. *J. Chem. Phys.* 5. *pp.* 113–124, *Feb.*, 1937.—The limitations of the simple collision theory for reactions are discussed. The Menschutkin and related reactions are shown to involve the formation of an activated complex with an electric moment of a magnitude which is calculated for the various cases. The free energy of activation for proton transfer is found from the experiments on conductance in water and the dispersion effects on polarisation in ice. A partition function for liquid H_2O and D_2O based upon experimental quantities is given. The abnormal rapidity of the denaturation of proteins in spite of an enormous activation energy is typical of reactions, involving the simultaneous breaking of many bonds. [See also Abstract 1206 (1935).] AUTHORS.

1302. Rates of Reaction in Solution. R. A. Ogg, Jr., and O. K. Rice. *J. Chem. Phys.* 5. *pp.* 140–143, *Feb.*, 1937.—The factors which may influence the rates of reactions in solution have been classified and discussed with particular reference to the effect on A in the expression $Ae^{-E/RT}$ for the rate constant K. Means by which these different effects may be studied experimentally have been discussed. An explanation has been given of the tendency of A and E to change in the same direction, and of K and E to change in opposite directions, when comparison is made of the rate of a given unimolecular reaction in various solvents. AUTHORS.

See also Abstract 1070.

VAPOUR PRESSURE.

1303. Activity Coefficients from Vapour Pressures. R. A. Robinson. *Am. Chem. Soc., J.* 59. *pp.* 84–90, *Jan.*, 1937.—Osmotic and activity coefficients have been determined by the isopiestic vapour pressure method for thallous nitrate, perchlorate and acetate, rubidium and cæsium nitrate and acetate, barium chloride, lanthanum chloride, potassium ferrocyanide and aluminium sulphate. The data for rubidium chloride, bromide and iodide and cæsium bromide and iodide have been redetermined. The possibility of incomplete dissociation of sodium, potassium, cæsium and thallous nitrate is discussed and it is shown that not only is this hypothesis consistent with Davies' extension of the conductivity equation but it also explains the abnormally low values found for the osmotic and activity coefficients of these salts. AUTHOR.

ACOUSTICS.

1304. Flexural Oscillations of Plates Having the Form of Parallelograms with Free Edges. B. Pavlík. *Ann. d. Physik,* 28. 4. *pp.* 353–360, *Feb.,* 1937.—The Chladni dust figures obtained with plates having the forms of parallelograms are found experimentally to resemble those obtained with rectangular plates. The differences are interpretable on the assumption that in the case of the parallelogram plates, more than one term in the series expansion, according to Ritz's theory, is of importance. Fairly good agreement is found between theoretical and experimental values of the frequencies of the plates, and the form of some of the dust figures can be accounted for theoretically. J. S. G. T.

1305. Asymptotic Property of Forced H.F. Vibrations of a Plate. A. Schoch. *Zeits. f. techn. Physik,* 17. 12. *pp.* 582–584, 1936.—The author considers the case of a vibrating system such as a plate or string subjected to a distributed periodic force which may vary with position and calculates the amplitude of vibration produced. A general formula is obtained and it is shown that as the frequency increases so the amplitude tends asymptotically towards a value which depends only on the superficial weight and the frequency. Experiments are described in which a sheet of material is excited electrostatically, with a uniformly distributed periodic force and the asymptotic effect is demonstrated. J. E. R. C.

1306. Optical Investigation of Ultrasonic Field in Liquids and Glasses. E. Hiedemann and K. H. Hoesch. *Zeits. f. Physik,* 104. 3–4. *pp.* 197–206, 1937.—A method is described by which photographs of the fine structure of ultrasonic waves are taken. These lead to a knowledge of the vibrations of the piezoquartz. The method is compared with a similar one used by Bär, also with the older diffraction method and with the Schlieren method. Investigation of the sound field in glasses explains the large number of elastic waves in various directions which appear in a glass block vibrating with high frequency, and brings out the conditions which are favourable to the excitation of waves due to bending. G. E. A.

1307. Simple Demonstration of Ultrasonic Waves in Liquids. L. Bergmann and H. J. Goehlich. *Phys. Zeits.* 38. *pp.* 9–13, *Jan.,* 1937.—A 4-W lamp with straight filament is placed 14 cm. away from the trough which holds the quartz vibrator. The filament is set parallel to the wave front. Stationary waves in xylol give bright and dark bands on a photographic plate 47 cm. from the other side of the trough. With the screen at 3 m. distance, the effect can be demonstrated to a large gathering. When the sensitive plate is at right angles to the trough, the system of bright and dark bands radiates out as from the filament source. When progressive waves are used, only one bright line with dimmer side lines are obtained. Various modifications of these experiments are described and photographed. No optical adjuncts are used. [See also Abstract 5221 (1936).] G. E. A.

1308. Hearing by Electrical Stimulation. S. S. Stevens. *Acoustical Soc. of America, J.* 8. *pp.* 191–195, *Jan.,* 1937.—Alternating current was led between the external meatus filled with saline solution and the inside surface of the forearm. The impedance of the body is made up of resistance and capacity, and was determined for frequencies from 125 to 8000 by an impedance bridge. The threshold of hearing was plotted as a function of the frequency, and gave 20 db at 125, 10 db at 500 and about 28 at frequency 8000. These effects were obtained from purely sinusoidal currents giving electrical stimulation without shock. With a sufficiently distorted wave-form, there is no lower limit of audibility. When the electrodes receive the output from a radio set, the quality of music heard is distinctly poor. The distortion produced in the ear is of such a nature as to introduce strong harmonics. To explain the electrophonic effect, it is supposed that the ear, like a condenser microphone, is capable of converting electrical into mechanical energy. It is also supposed that some degree of rectification of the current occurs within the body. G. E. A.

***1309. Sound Wave Stroboscope. B. F. McNamee.** *Electronics*, 9. *pp.* 24–26 *and* 34, *Nov.*, 1936.—Full details are given of a method of using thermionic valves to control the spark discharge used for photographing sound waves by refraction shadows. Eight of the illustrations deal with geophysics. Small scale models similar to those used in studying architectural acoustics are made to represent typical earth formations and the sound from one spark gap, situated in the model at a place corresponding to the charge of explosive in a geophysical survey, is used to represent the seismic wave. The models can then be modified so that the succession of sound waves received at the seismograph point in the model corresponds to the succession of seismic waves received at the seismograph in the survey. W. H. Ge.

***1310. Ultrasonic Stroboscope. R. Bär.** *Helv. Phys. Acta*, 9. 8. *pp.* 678–688, 1936. *In German.*—The passage of a plane light wave through two consecutive ultrasonic waves not illuminated stroboscopically produces stroboscopic effects which are described and explained. An arrangement is described in which the distance of the bands behind the first sound wave is indefinitely great, and the light intensity over the whole field is modulated with the frequency of the sound wave. The ultrasonic stroboscope is used in demonstrating a nonplanar sound wave field in the frequency region 7–10,000 kc. An Appendix deals with the position of the diffraction spectra for oblique incidence of the light on the sound waves. G. E. A.

1311. Scale of Psychological Magnitude Pitch. S. S. Stevens, J. Volkmann and E. B. Newman. *Acoustical Soc. of America, J.* 8. *pp.* 185–190, *Jan.*, 1937.—A subjective scale for the measurement of pitch is constructed. Five observers were required to adjust the frequency of a variable tone until it sounded just half as high in pitch as a standard tone of 60 db. The standard tones lay between 125 and 12,000 ~. The averaged results were plotted, and a smooth curve drawn through the points. The 1000 ~ tone was given the pitch number 1000, the one which sounded half as high 500, and so on. This gave another curve called the pitch function, in which the pitch in " mels " is related to the frequency. The pitch function curve is found to agree with another obtained by integrating the DL's (just detectable increments in frequency) as determined by Shower and Biddulph, from which it is concluded that all DL's for pitch, at a constant loudness level, are of equal subjective magnitude. The relation of the pitch scale to basilar mechanics and to the subjective size of musical intervals is discussed. G. E. A.

See also Abstracts 1023, 1061, 1245.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

1312. Design of a Mechanical Analogy for the General Linear Electrical Network with Lumped Parameters. M. Pawley. *Frank. Inst., J.* **223.** *pp.* 179–198, *Feb.*, 1937.—A mathematical paper dealing with the theoretical aspects of mechanical analogies of electric circuits comprising combinations of resistances, inductances and capacitances. The corresponding electrical and mechanical terms are given as follows :—

Electrical network		*Mechanical system*	
mesh		flywheel	
open-circuited		clamped	
i_2, i_1		ω_2, ω_1.	
voltages		torques	
inductance,	L	moment of inertia,	K
resistance,	R	damping constant,	f
elastance,	S	spring constant,	k

E. H. W. B.

CONDUCTION AND DISCHARGE IN GASES.

1313. Ionising Radiations Emitted by Electric Discharges in Air. G. Déchène. *J. de Physique et le Radium*, **7.** *pp.* 533–544, *Dec.*, 1936.—The strongly absorbed ionising radiations emitted by non-condensed electric discharges in air are studied by means of the ionisation chamber, care being taken to eliminate the errors of some of the previous work. It has been verified that the observed effects are due to ionisation by the " discharge rays " and not due to photoelectric effects on the surfaces of the apparatus or on the dust in the air. The coefficients of absorption of the radiation by air and other substances have been measured. From these results it is concluded that these rays are in the Lyman region. C. J. B. C.

1314. Corona Motor. H. Teichmann. *Zeits. f. Physik*, **103.** 11–12. *pp.* 738–746, 1936.—An account is given of the experiments on the corona rotation effect first described by Güntherschulze and Hesse [see Abstract 4646 (1935)]. Wires of Cu and Pt show an erratic increase of the rotation depending on high voltage. This instability follows upon strong variations of the amplitude in which there are often observed missing harmonics. With an almost rigid arrangement, a kind of corona motor, in place of the wire the course of the velocity of the perimeter as function of the high voltage was stable. Measurements on the dependence of the perimeter velocity of this motor on the strength of field without heating gave quite contrary results to those with heating, *viz.*, great perimeter velocities with negative polarity, smaller with positive polarity. Preliminary ionisation with a quartz lamp has only influence on the perimeter velocity with negative polarity, and indeed v is smaller. J. J. S.

1315. Cloud-Chamber Investigations of Electric Breakdown in Gases. E. Flegler and H. Raether. *Zeits. f. Physik*, **104.** 3–4. *pp.* 219–220, 1937.—The authors disagree with R. Holm's criticism [see Abstract 4828 (1936)]. R. P.

1316. Temperature Dependence of Mobility of Ions in Pure Gases. L. G. H. Huxley. *Phil. Mag.* **23.** *pp.* **208–210,** *Feb.,* **1937.**—Measurements of Tyndall and Pearce [see Abstract 3793 (1936)] of the temperature dependence of the mobility of nitrogen ions in nitrogen and Cs and Na ions in He are shown to be in satisfactory agreement with the formula $AT^{\frac{1}{2}}/(C + T)$, where A and C are constants. This formula is based on an approximate theory by Sutherland, in which the polarisation forces are taken into account. R. P.

1317. Accommodation Coefficient of Positive Ions near a Probe Surface. N. Morgulis. *Phys. Zeits. d. Sowjetunion,* **10. 4.** *pp.* **565–566, 1936.** *In German.*—The note consists of a criticism of an equation given by Molthan [see Abstract 807 (1936)], for the total heat exchange in a probe in a gas discharge. It is pointed out that the equation represents a special case, and a more general formula is suggested. J. E. R.

1318. Glow Discharges in Helium. K. G. Emeleus, F. D. Greeves and E. Montgomery. *Roy. Irish Acad., Proc.* **43***A.* *pp.* **35–47,** *Oct.,* **1936.**—The negative glow and Faraday dark space of some cold kathode discharges in He are studied with probes for gas pressures down to 0·4 mm. Hg. For lower pressures under the conditions of experiment probes cannot be used, the discharge being of another form. The positive column of the discharge tube shows characteristic changes as the pressure is reduced. These changes are accompanied by changes in the electron velocity distribution in the negative glow. The nature of the connection between negative glow and positive column is discussed. A group of electrons with a mean energy of the order of 5 eV is probably always present in the negative glow. It is suggested that these are the electrons ejected in collision between the fast electrons from the kathode dark space and gas molecules, their roughly constant mean energy being understandable from collision theory. The slowest group of electrons present, which is identical with this group only if the current density is low, has a deficit of medium speed electrons, compared with a Maxwellian distribution, of the general nature predicted by elastic collision theory. AUTHORS.

1319. Dynamics of the Glow Discharge. Parts I and II. W. Druey. *Helv. Phys. Acta,* **9. 9.** *pp.* **707–744, 1936,** *and* **10. 1.** *pp.* **3–31, 1937.** *In German.*—The properties of the static gas discharge have been fully investigated, both experimentally and theoretically, but the problem of the variations in the discharge at its starting point cannot be explained on elementary ionisation theories. A discharge tube system suitable for such investigations is described. An elaborate arrangement of oscillating switches and relays makes it possible to investigate the time changes of the discharge current over a wide range of conditions. The characteristics of this system are discussed in detail and its advantages over the kathode-ray oscillograph outlined. In the development of a glow discharge in argon two distinct effects are observed. There is a preliminary current peak which is followed by a damped current oscillation (effect A); then comes a further and independent drop in the current (effect B). The extent of these effects is shown to depend on electrode spacing and capacity voltage, etc. Similar observations were carried out on discharges in He, H_2 and N_2. In all these gases effect A is very pronounced, though in the case of H_2 it is critically dependent on the electrode spacing. In Part II, a comprehensive theoretical discussion of the first stages of a gas discharge is given on the basis of the Townsend ionisation theory. For this purpose the effects occurring in the discharge tube are divided into two parts, referred to the kathode and anode ends respectively. It is suggested that the effect A is due to the building up of the ion current at the kathode end, and the effects of voltage, current, electrode capacity, etc., on this process are discussed in detail. The effect B is due to the development of the anode fall, and the value of this fall can be calculated in any particular case from the change in current and the external resistance. All the observed effects are explained qualitatively on this basis. J. E. R.

1320. Glow Discharge. F. H. Newman. *Phil. Mag.* 23. *pp.* 239–241, *Feb.*, 1937.—Two iron electrodes are placed in a good vacuum (less than 10^{-3} mm. Hg) a few mm. apart, with a steady p.d. between them. If, then, a momentary discharge is set up between one of them and an auxiliary electrode, a brilliant glow is produced, which, however, has the characteristics of a glow discharge rather than those of an arc. This observation is discussed in connection with observations of other authors on glow discharges without dark space which are produced between electrodes having a thin insulating coating. R. P.

1321. Electric Discharge through Open Capillary Tube. H. Takô. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 672. *pp.* 30–41, *Jan.*, 1937. *In English.*—An investigation is made of the discharge at low pressure in a capillary tube expanded in the centre, the open ends of the tube being placed between the ball electrodes of a static influence machine. The nature of the spark depends on the capacity of the circuit; above a critical value there is a violent white discharge and below this value the discharge is weak and bluish. The other main factor is the capillary diameter, and critical values at which a separation between the white and blue discharges can be detected is determined under various conditions. The white discharge is accompanied by helical cracks in the tube, increasing in size with the discharging. The spectrum is continuous and the NaD line and some Si lines are reversed, such lines being resonance lines of neutral atoms corresponding to transitions from the lowest to the next higher energy levels. At high capacity and small capillary section there is a marked broadening of the D absorption lines, a consequence of the Stark effect due to the electric field of the space ion charge at that point. Finally, the amount of charge conveyed by the air stream from the tube is measured in relation to capillary section. N. M. B.

1322. Stroboscopic Measurements on Gas Discharges. J. Kern. *Ann. d. Physik*, 28. 2. *pp.* 169–184, *Jan.*, 1937.—By using a Kerr cell with two crossed Nicols, and exciting it from a h.f. circuit of adjustable phase angle, stroboscopic measurements of a light source supplied at the same frequency may be made. In the present work the light source is a discharge tube, containing A, N_2 or O_2 at 1–4 mm. and passing about 30 mA. The work is in two sections: the first in which the tube is excited at the high frequency (300 m. or 1000 m. wave-length), and curves of relative intensity of light at all points of the cycle of applied voltage are obtained, and the second in which the voltage obtained from the h.f. source is rectified before it is applied to the discharge tube. The time constant of the afterglow is then obtained. Results agree fairly with, but are more extensive than, those of Rohde and Schnetzler, which are given for comparison [see Abstracts 2976 and 4532 (1932)]. W. H. W.

1323. Ionic Current in a Gas Discharge. G. Zimmermann. *Zeits. f. Physik*, 104. 3–4. *pp.* 309–334, 1937.—The current in a hot kathode discharge tube may be divided into three parts, diffusion current, gradient current and ionic current. The theory of the first two is well known and the present observations are concerned chiefly with the ionic flow. Apparatus is described for the production and investigation of a very steady discharge in HCl at low pressures. General observations on the discharge show that the diameter of the positive column is the most critical characteristic. A number of observations were made of the probe characteristics of the discharge, and detailed results are given. At higher pressures, the discharge ceases to be static, and under these conditions, the characteristics were investigated by means of a kathode-ray oscillograph. With these experiments in view, a detailed theoretical survey is made of the distribution of the current carrying ions. The results may be reduced, using reasonable assumptions, to four comparatively simple equations connecting the number of ions present, the gas pressure, discharge current, dimensions of the ion column, etc. The theory appears to give a good account of the experimental results. J. E. R.

1324. Space-Charge Weakening by Shot and Flicker Effects. W. Schottky. *Physica*, 4. *pp.* 175–180, *Feb.*, 1937. *In German.*—Calculations are made of the amount of weakening of the space-charge due to (*a*) the small shot effect and (*b*) the flicker effect. Experimental results were found to be in agreement with the formulæ here derived. A. W.

1325. Kinetic Energies of Atomic Ions Formed by Electron Impact in Nitric Oxide and Hydrogen Chloride. E. E. Hanson. *Phys. Rev.* 51. *pp.* 86–94, *Jan.* 15, 1937.—The formation of high energy positive ions, as predicted by quantum mechanics in the case of H_2, has already been confirmed in molecular gases, and a more detailed study for NO and HCl is reported. The energy distribution of the atomic ions was measured as a function of the electron energies at impact, and ionisation potentials were determined. The most probable values of the heats of dissociation of the molecules and molecular ions are calculated. Negative ions of energy up to 2·5 V were observed in NO, leading to a calculated electron affinity of 2·1 ± 0·5 V for O. Negative ions found in HCl had less than 0·5 V energy. Details and data of nine probable processes are given. N. M. B.

1326. Ionisation Potential of Carbon Monoxide. J. Savard, M. de Hemptinne, and P. Capron. *Comptes Rendus*, 204. *pp.* 354–356, *Feb.* 1, 1937.—Investigations previously reported for N_2 [see Abstract 3607 (1935)] are extended to CO. Observed and calculated values and term interpretations are tabulated in the region 12·5 – 19 eV for 21 potentials, mostly resonance potentials due to the additive combination of two spectral terms. Results indicate the value 13·5 eV for the ionisation potential of the normal molecule. N. M. B.

1327. Passage of Heavy and Light Hydrogen Ions through Argon. F. Wolf. *Ann. d. Physik*, 28. 4. *pp.* 361–374, *Feb.*, 1937.—A method already described [see Abstract 324 (1937)] is utilised to measure the discharge diameters of D^+ and $D_2^+ \rightarrow$ A as well as the effective diameters of D^+ and $H^+ \rightarrow$ A as a function of the ionic velocity. The discharge diameter for $D^+ \rightarrow$ A is the same as that of $H^+ \rightarrow$ A. For small ionic velocities certain anomalies appear which have been recorded in earlier work. The experimental results are given in graphical form and certain differences between these and those of other workers are pointed out. H. J. H. S.

***1328. New Mass-Spectrograph Measurements. J. Mattauch.** *Akad. Wiss. Wien, Ber.* 145. 2*a*. 7–8. *pp*. 461–478, 1936.—A new mass-spectrograph, the theory of which has been described previously [see Abstract 3860 (1934)] is constructed, tested and found capable of fulfilling all theoretical expectations with regard to sensitivity, resolving power and range of mass scale. A new isotope ^{84}Sr is discovered with an abundance ratio of $\frac{1}{3}$ %. The dissociation of carbo-hydrides and other molecules is followed by observation of new bands in predetermined positions. The high resolving power permits for the first time the splitting of mass lines of a definite mass number into triplets and the observation and measurement of the rare isotopes ^{15}N and ^{18}O separate from the adjacent lines of $^{12}C^1H_3$ and $^{16}O^1H_2$ respectively. The mass differences $^{12}C^1H_3 - {}^{15}N$ and $^{16}O^1H_2 - {}^{18}O$ are measured as $0 \cdot 02382 \pm 0 \cdot 000075$ and $0 \cdot 01257 \pm 0 \cdot 00018$ respectively. The recently measured mass-spectrograph doublets are compared as far as possible with the heats of reaction of nuclear reactions and in the case of isotopes of some light elements the mass values in best agreement with the observations are deduced. J. E. K.

1329. Ionisation, Excitation, and Chemical Reaction in Uniform Electric Fields. Part III. Excitation of the Continuous Spectrum of Hydrogen. R. W. Lunt, C. A. Meek and E. C. W. Smith. *Roy. Soc., Proc.* 158*A*. *pp*. 729–738, *Feb*. 3, 1937.—Experiments are described in which the energy efficiency of the excitation of the continuous spectrum of H_2 ($^3\Sigma_g{}^+ - {}^3\Sigma_u{}^+$) has been determined in arbitrary units as a function of Xp^{-1}, the ratio of the field to the pressure, in the uniform positive column discharge through rapidly streaming H_2. For values of Xp^{-1} from 25 to 140 the theoretical values of the energy efficiency derived in Part II [see Abstract 4822 (1936)] are in good agreement with the results of these experiments; the data of Chalonge indicate that the agreement probably extends to $Xp^{-1} = 10$. For higher values of Xp^{-1} the theoretical values of the energy efficiency diminish more rapidly than the experimental ones. AUTHORS.

***1330. Counting of Electrons by Means of a Discharge Tube. J. H. Gisolf.** *Physica*, 4. *pp*. 69–70, *Feb*., 1937. *In English*.—An arrangement is described, with which it is possible to use discharge tubes of different types as electron counters. AUTHOR.

See also Abstracts 980, 1158, 1209, 1212, 1247, 1262.

CONDUCTION IN SOLIDS AND LIQUIDS.

1331. Electrophysics of Solid Bodies. C. Metallic Electronic Conductors. A. Smekal. *Die Physik*, 4. 5. *pp*. 193–204, 1936.—A review of papers dealing with electronic conduction in metallics, which have appeared between 1933 and 1 Dec., 1936, continuing previous work [see Abstract 5661 (1936)], under the following heads: 16. General. 17. Metallic conductivity of elements, alloys and compounds. 18. Temperature dependence of the specific resistances of metals. 19. Dependence of the resistance of metal crystals on direction, especially in magnetic fields. 20. Electrical properties of thin films and wires. 21. General theory of metallic electronic conduction. 22. Theory of conduction properties of some metallic substances. 23. Supraconduction. D. R. H.

1332. Electron Theory of Metals. Part II. S. Schubin and S. Wonsowsky. *Phys. Zeits. d. Sowjetunion*, 10. 3. *pp*. 348–377, 1936. *In German*.—An earlier work [see Abstract 3611 (1935)] is extended to a consideration of a problem arising from the electron theory of metals from the viewpoint of the Heitler-London approximation. The characteristic spectrum and the " eigenfunction " are calculated for a certain simple case. H. J. H. S.

***1333. Calibrated Source of H.F. Voltage. S. Githens, Jr.** *Rev. Sci. Instruments*, 8. *pp.* 48–50, *Feb.*, 1937.—The difficulties encountered in h.f. voltage measurements can be avoided by the use of an oscillator which measures the voltage it generates. The design, construction and calibration of such an oscillator are herein outlined. AUTHOR.

***1334. Absolute Determination of the Ampere. P. Vigoureux.** *Roy. Soc., Phil. Trans.* 236*A*. *pp.* 133–154, *Dec.* 15, 1936.—The current balance erected at the National Physical Laboratory in 1905 by Ayrton, Mather and Smith was overhauled, new coils were constructed, and numerous measurements of current were effected between 1930 and 1935. The results indicate that the ampere is 14 ± 3 parts in 100,000 greater than the unit of current realised at the Laboratory by means of resistance coils and cadmium cells. This value for the ampere exceeds by 2 parts in 100,000 the value found by Ayrton, Mather and Smith in 1907. AUTHOR.

1335. Anomalous Variation of H.F. Resistance in Quartz. K. Nakamura. *Tohoku Univ., Sci. Reports*, 25. *pp.* 590–597, *Nov.*, 1936. *In English.*—An anomalous variation of h.f. resistance of a quartz plate cut perpendicularly to its optical axis is studied and it is found that the minimum value of h.f. resistance decreases as the frequency of oscillation increases, and that the relation between the minimum resistance R_m and its temperature T_m can be given by $R_m = Ae^{2\alpha/T_m}$, where A and α are constants. The temperature at which the resistance becomes the minimum depends also upon the frequency to be measured, which is represented by the formula: $f = Be^{-\alpha/T_m}$. From the above equations, the following relation, which is approximately satisfied by the experimental data, is obtained: $f^2R_m = \text{constant}$. [See also Abstract 5035 (1933).] AUTHOR.

1336. Nature of the Supraconducting State. J. C. Slater. *Phys. Rev.* 51. *pp.* 195–202, *Feb.* 1, 1937.—In the usual electron theory of metals, the interaction between the electrons is not taken into account. A more accurate treatment would have to include this interaction and the author assumes that this would, in addition to the continuous energy spectrum of the ordinary motion of the electrons, lead to a few discrete levels of lower energy. On that assumption one obtains a phase transformation at low temperatures. The electric and magnetic properties of the lower phase and the nature of the transition are not discussed, but it is identified with the supraconducting phase. On this view it can be understood why monovalent metals are not supraconductors, and the transition metals should only become supraconducting at very much lower temperatures than have been investigated up to now. R. P.

1337. Change of Resistance of Thin Metal Sheets with Time. V. Vand. *Zeits. f. Physik*, 104. 1–2. *pp.* 48–67, 1936.—Thin sheets of Ag and Au prepared by evaporation and situated in a high vacuum are found to exhibit a hyperbolically increasing resistance with time. Admittance of air produced only a slight increase in resistance. The effect is shown to be due to disintegration of the crystal lattice. F. C. C.

1338. Electrical Conductivity of Thin Metallic Films. Part II. Cæsium and Potassium on Pyrex Glass Surfaces. E. T. S. Appleyard and A. C. B. Lovell. *Roy. Soc., Proc.* 158*A*. *pp.* 718–728, *Feb.* 3, 1937.—The method recently described for measuring the resistivity of thin films of Rb on clean substrates in very high vacua has been extended to Cs and K. Conductivity has been observed with Cs films of only 0·3 Å in thickness. The decay of conductivity normally shown by these films after cessation of the deposition decreases in the order K—Rb—Cs for a film under given conditions. At the lowest temperature used (64° K.), Cs films of only a few Å in thickness are stable. The resistivities of the stable films again show excellent agreement with the formula previously derived; for Cs down to a few Å in thickness. The work on Cs and K has given further support to the hypothesis previously developed to explain the phenomenon of the decay of conductivity. [For Part I see Abstract 5246 (1936).] AUTHORS.

1339. Resistance Measurements with Boron and Silicon Carbide. F. P. Henninger. *Ann. d. Physik,* **28.** 3. *pp.* 245–263, *Feb.,* 1937.—B and SiC are usually believed to have a very high resistivity which depends strongly on temperature and on voltage. Measurements are made in order to study and exclude the influence of surface layers. It is shown that a large part of the observed voltage dependence is due to heating of the specimen. Since the resistance is concentrated in thin layers, comparatively weak current may produce strong heating effects. These are eliminated by passing d.c. and a.c. at the same time, and varying their intensities in such a way that the total Joule heat remains constant. In this way the resistance is found to be less strongly dependent on the current. The voltage is then increased up to several kV. In order to eliminate heating a spark method is used which allows the voltage to be applied for a very short time. After passing once a very strong current, the resistance of SiC drops permanently to a low value which depends little on temperature and may be as low as 2 ohm.cm. The results for B were less definite, since only three specimens were available, of which two broke in the course of the measurements. It is probable that the volume resistivity of pure B is lower than 1 ohm.cm. R. P.

1340. Conductivity of Salts in *n*-Propyl and Isopropyl Alcohols. F. Hovorka and J. C. Simms. *Am. Chem. Soc., J.* **59.** *pp.* 92–95, *Jan.,* 1937.—The conductivities of KI and KBr and of NaI and NaBr have been determined in propyl and isopropyl alcohols. The limiting equivalent conductivities were calculated by the Fuoss and Kraus method and were compared with those obtained by extrapolation of $\Lambda_0 - \sqrt{C}$ curves. The dissociation constants were calculated by the Fuoss and Kraus, and Ostwald methods for each electrolyte. It is shown that the former method yields greater but quite constant values. Furthermore, the values of the dissociation constants indicate that all of the salts used here may be considered as weak electrolytes in propyl and isopropyl alcohols. There seems to exist no relation in the order of conductivities of the salts in these two alcohols nor does the principle of additivity apply in either alcohol. AUTHORS.

1341. Conductivity of Rochelle Salt Crystals. F. Seidl. *Akad. Wiss. Wien, Ber.* **145.** 2*a*. 7–8. *pp.* 515–523, 1936.—Describes measurements of the d.c. conductivity of single and multiple crystals of Rochelle salt at temperatures from 20° C. to the melting point (60° C.), and at various voltages. E. R.

See also Abstracts 1160, 1199, 1281, 1370

DIELECTRICS AND CAPACITANCE.

1342. Dipole Moment of Sulphur Trioxide. A. Smits, N. F. Moerman and J. C. Pathuis. *Zeits. f. phys. Chem.* 35. *Abt.B.* 1. *pp.* 60–68, 1937.—The dielectric constant of the complex SO_3 has been estimated and from the results it is concluded that the simple SO_3 molecule has a planar configuration and possesses practically no permanent dipole moment. W. R. A.

1343. Dipole Moments of Vapours. Part III. L. G. Groves and S. Sugden. *Chem. Soc., J. pp.* 158–162, *Jan.*, 1937.—By combining the measurements on the vapours of some 20 substances with recorded data, the moments of the first four or five members of a number of homologous series have been obtained. Induction along the hydrocarbon chain does not completely explain changes in the value of the moment on ascending a homologous series. New dielectric matter introduced into the molecule may alter the distribution of the electric field around the dipole, and may influence the changes in moment to a greater extent than induction. A comparison of some normal and branched chain compounds supports this view. [For Part II see Abstract 3978 (1935).] W. R. A.

1344. Dipole Moment and Structure of Pyrones. M. A. G. Rau. *Indian Acad. Sci., Proc.* 4*A. pp.* 687–697, *Dec.*, 1936.—The moments of 2·6 dimethyl-γ-pyrone, xanthone, and coumarin are determined in benzene solutions at 10°, 20°, 30° and 40° C. The values for 20° are 4·48, 2·93 and 4·51 respectively. The high moments for these pyrones are due to the state of resonance in which they exist, between the unexcited states of low moments and excited states of high moments. The difference in value between the moments of dimethyl-γ-pyrone and xanthone must be due to the greater number of unexcited parent states for the latter. The small difference between the calculated and observed moments for coumarin is due to the moments of some of the excited phases being in the opposite sense to the normal value. AUTHOR.

1345. Dielectric Polarisation of Liquid Chloronitrobenzene. A. Jagielski. *Acad. Polonaise Sci. et Lettres, Bull. No.* 8–9*A. pp.* 451–456, *Oct.–Nov.*, 1936. *In German.*—Densities and dielectric polarisations of the three isomers are given. W. R. A.

1346. Electric Susceptibility in a Magnetic Field. N. Dallaporta. *N. Cimento,* 13. *pp.* 407–422, *Nov.*, 1936.—The influence of a magnetic field on the dielectric constant of a single atom or molecule is treated theoretically and it is found that the theoretical value is several thousand times too small to account for the effects observed by Piekara and Schérer [see Abstract 5210 (1934)]. It is suggested that the discrepancy is due to the fact that the experiments refer to the dielectric constant for a.c. which may be different from the d.c. value if the liquids under investigation, owing to association, have absorption bands in the region of Hertzian waves. R. P.

1347. Effect of Space-Charges on Electric Strength of Calcite. A. Wenderowitsch and A. Worobjow. *Phys. Zeits. d. Sowjetunion,* 10. 3. *pp.* 413–420, 1936. *In German.*—It is shown that when calcite has previously been polarised by the application of a constant voltage, the breakdown voltage (d.c.) is decreased or increased, depending on whether the breakdown voltage is in the same or opposite direction to the polarising voltage. This effect is observed only for specimens of thickness less than 0·2 mm. E. R.

See also Abstracts 1080, 1177, 1335.

ELECTROCHEMISTRY.

1348. Lithium Amalgam Concentration Cells with Non-Aqueous Solutions. G. Spiegel and H. Ulich. *Zeits. f. phys. Chem.* 178. *Abt.A.* 3. *pp.* 187–192, 1937.—Activity coefficients are investigated for non-aqueous *N*/10 LiCl solutions by methods previously described for Na halides [see Abstract 4849 (1936)]. E.m.f.'s are determined for seven Li amalgams of concentrations between 0·001121 % and 0·08012 % (saturation), in the cell Li amalgam $(C_1)|(N/10)$ LiCl|Li amalgam (C_2). By Lewis and Randall's method $f = 1 + 26\cdot5\ (c)$ for Li, against $1 + 43\cdot0(c)$ for Na previously established. The amalgams attack ethyl alcohol evolving H_2, and in acetone and acetonitrile light precipitates are formed slowly, nevertheless e.m.f.'s agree to less than a millivolt. Values of *f* derived from the double cell Ag|AgCl|LiCl(c_1)|Li amalgam ·00822 % dropping electrode|LiCl(c_2)|AgCl|Ag obey the relationship $\log f = -1\cdot583\sqrt{c}$. The combined correction for Debye and Hückel's radius effect and Bjerrum's association of ions is best satisfied by (radius of Li$^{\cdot}$ + radius of Cl$'$) $= (4 \pm 1) \times 10^{-8}$ cm. From conductivity measurements a value of 6·6 is obtained for solvated ions. This agreement is regarded as satisfactory, showing that LiCl is almost completely ionised in *N*/10 acetonitrile solution. D. R. H.

1349. Application of Electrolytic Polishing to a Study of Metallic Deposits. P. Jacquet. *Comptes Rendus,* 204. *pp.* 172–174, *Jan.* 18, 1937.—An examination of metallic deposits by means of X-rays or electron diffraction shows that the base metal exerts an orientating influence on the metal crystals which are deposited. A micrographic examination of the surface is rendered difficult without first performing a destructive polishing process. Experiments are described in which Cu is deposited electrolytically (using a bath containing acidified $CuSO_4$ solution) on a Cu surface; this gives a highly polished surface which may readily be examined with the microscope. The nature of the deposit obtained under varying conditions of current density is described.

H. J. H. S.

1350. Electrolysis of Aqueous Solutions of Ammonium Bromide. F. Jirsa. *Zeits. f. Elektrochem.* 43. *pp.* 77–81, *Feb.*, 1937.—The electrolysis of aqueous solutions of NH_4Br is studied at temperatures of 25° and 72° C. The current densities varied from 2·2 to 61·8 A/dm^2. The electrodes were Pt. The results of the electrolysis are the production of Br, HBr, N_2 and a small amount of O_2 at the anode. The quantity of each individual product depends upon the concentration of the solution, the current density and the temperature. The dependence upon these factors is estimated. The decomposition of bromamine, NH_2Br, causes the yield of Br_2 to be lower than 100 %. F. J. B.

1351. Current Distribution near Angular Electrodes. W. Kangro and K. M. Wagner. *Zeits. f. Elektrochem.* 43. *pp.* 119–127, *Feb.*, 1937.—Current density outside the electrode boundary decreases logarithmically with distance, enabling a distribution constant to be calculated. For $CuSO_4$, $ZnSO_4$, $CuCl_2$, this has values from 0·2 to 0·5 cm^{-1}. and depends on concentration. Within the electrode boundary the curve diverges logarithmically from that obtained assuming no distribution of current, and the constant thus derived depends on the angle of the kathode. For 30° and 60° the current density is a minimum at the centre and increases at the corner. For ideal conditions boundary values are derived identical with those applicable outside. The dependence of distribution constants on total current, conductivity, ionic concentration and nature of the ions, is discussed. D. R. H.

1352. Glow of Barrier Anodes of Aluminium. Part II. K. Gumiński. *Acad. Polonaise Sci. et Lettres, Bull. No.* 8–9*A*. *pp.* 457–469, *Oct.–Nov.*, 1936. *In English.*—Previous work is continued [see Abstract 3843 (1936)] on the glow of an Al electrode. The dependence of the glow upon the concentration of the electrolyte, the distribution of the intensity in the spectrum of the glow and the degree of polarisation of the light emitted are investigated and the results are discussed. F. J. B.

1353. Adsorbed Atoms and Ions on the Surface of a Platinum Electrode. A. Frumkin and A. Slygin. *Acta Physicochimica*, 5. 6. *pp.* 819–840, 1936. *In English.*—The surface conditions of the Pt electrode are investigated in acid and alkaline solutions of NaCl and NaBr. The adsorption of H_2 on Pt is studied and it is found that when the usual Pt electrode is platinised and sintered at 300° C., the surface is reduced some 30 times. Data obtained enable the amount of adsorbed gas at the electrode surface to be determined, as well as the charge of the double layer. A method for the investigation of the changes in the properties of the Pt surface on progressive heating and the influence of the composition of the solution on H_2 adsorption is developed. F. J. B.

1354. Cells with Dissimilar Electrodes. Suzanne Veil. *Comptes Rendus*, 204. *pp.* 242–244, *Jan.* 25, 1937.—If in the Pt/gelatin/Zn cell previously described [see Abstract 5197 (1935)] ordinary tap water replaces the gelatin practically the same e.m.f. is obtained. This intervention of H_2O or gelatin has an important effect where corrosion may occur; thus the cell Pb (pure)/H_2O/Pb (coated with PbO_2 by treatment with dilute H_2SO_4) has an initial e.m.f. of 1·4 V. which after a time decreases, probably on account of reduction of the PbO_2; this decrease is much more rapid if gelatin replaces H_2O. A similar cell with amalgamated Zn in place of the pure Pb (H_2O being retained) gives an e.m.f. of approximately 1·90 V.; but that of the cell amalgamated Zn/H_2O/Zn is only 0·20 V. If the two electrodes are in different solutions a higher e.m.f. is obtainable, *e.g.* Zn/Na_2S (satd. sol.)/gelatin/$Fe(NO_3)_3$(satd. sol.)/Pt gives initially 2·05 V. C. A. S.

1355. Anode Potential of Chromium with Asymmetric A.C. Electrolysis. A. Geldbach and M. Schlötter. *Zeits. f. Elektrochem.* 43. *pp.* 91–103, *Feb.*, 1937.—The anodic potential of Cr is determined with thermite Cr for alternating current superimposed on direct current. The dependence of the a.c. component and the d.c. component on the different frequencies in the range 30 to 10000 $\sim$ is determined in solutions of *N* H_2SO_4 and *N* HCl. The bearing of the results of the theory of the active and passive states of Cr are discussed. [See also Abstract 363 (1937)]. F. J. B.

See also Abstracts 1261, 1296, 1303.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

* **1356. Diffraction of Electrons by Silver and Gold Films Formed by Kathodic Deposition on Crystalline Substrates. A. Bojinescu.** *Soc. Roumaine Phys., Bull.* 37. 67. *pp.* 3–18, 1936. *In German.*—A diffraction camera is designed for use with a hot or cold kathode, and a multiple diaphragm system, without electromagnetic focusing, is

employed. The specimen carrier is of the simplest form and no adjustments are possible. A motor-driven electrostatic machine is used as the h.v. source (50 kV), and with discharge currents of the order of 0·2mA and a camera length of 13·5 cm. the exposure times are 1–5 sec. In the work described, Au and Ag films are sputtered on the faces of soluble crystals at room-temperature, and subsequently stripped for use as transmission specimens. It is shown that, when deposited on rock-salt, both Au and Ag films gradually change from small random crystals to a single crystal in cube-face orientation as the film thickness, determined by Fery's method, is increased from 15 mμ to 95 mμ. No such effect is observed with $NaNO_3$, KI, $CuSO_4$, alum or tartaric acid substrates, as even thick metal films are polycrystalline. It is suggested that the temperature of deposition does not fall within the region of the electric Curie points of these substrates, which therefore have little influence upon the deposited metal. A. G. Q.

1357. Motion of Electrons in Gases in Electric and Magnetic Fields. L. G. H. Huxley. *Phil. Mag.* 23. *pp.* 210–230, *Feb.*, 1937.—A new derivation of the formula connecting mean drift velocity in a given electric field with the mean free path is given. The result differs by a factor $\frac{3}{4}$ from the usually accepted formula, but agrees with a formula given by Townsend. The corresponding argument is carried out for the case of a magnetic field and it is shown that the deflection of a beam in a magnetic field, expressed in terms of the mean drift velocity, is independent of this correction factor. R. P.

1358. Dynamical Theory of Electron Diffraction and its Application to Surface Problems. J. W. Harding. *Phil. Mag.* 23. *pp.* 271–294, *Feb.*, 1937.—A theory of electron diffraction based on that of Darwin for the case of X-rays has been developed, and Darwin's equations have been generalised to allow for an arbitrary arrangement of planes near the crystal surface. On the basis of this theory an attempt has been made to explain the observed discrepancy in the experimental breadth of the region of selective reflection and that predicted by the Bethe theory. It is shown that the general features of the experimental results may be obtained by assuming that a few planes near the surface have a contracted spacing relative to that of the crystal interior. The magnitude of the effect suggests that these contracted planes are due to a gas layer on the surface rather than to a contraction of the crystal itself near the surface. AUTHOR.

1359. Convergence and Achromatism of Centred Electron-Optical Systems. M. Cotte. *Comptes Rendus*, 204. *pp.* 170–172, *Jan.* 18, 1937.—Glaser and Scherzer [see Abstract 4366 (1936)] have shown that an electron-optical centred system, free from space charge, is always convergent and cannot be achromatised. An equation derived by Glaser is quoted and from it expressions are derived which show that, under certain conditions, the system may be divergent. Thus, if the space charge has the same sign as the particles (electrons or positive ions), the system may be achromatised. H. J. H. S.

See also Abstracts **962, 963, 981, 982, 983, 1000, 1001, 1053, 1168, 1184, 1327, 1349, 1396.**

ELECTROSTATICS.

1360. Limiting Electric Charge of Very Fine Particles. M. Pauthenier and C. Martin. *Comptes Rendus*, 204. *pp.* 239–240, *Jan.* 25, 1937.—The theory already shown experimentally to be valid for particles of sizes 20–360μ and 1—7 mm. is now shown to be equally valid for particles 2—20μ. [See Abstract 4463 (1932).] C. A. S.

1361. Two-Dimensional Potential Theory. Part I. Force and Couple in Electrostatic Problems. Rosa M. Morris. *Phil. Mag.* 23. *pp.* 246–251, *Feb.*, 1937.—It is pointed out that the results for the force per unit length and the couple on a cylindrical conductor in a two-dimensional electrostatic field can be found by the evaluation of the respective complex integrals $(1/8\pi)\int(\partial\,\Omega/\partial\,z)^2dz$ and $(1/8\pi)\int(\partial\,\Omega/\partial\,z)^2z\,dz$, round the contour of the cross-section of the cylinder. The complex function, Ω, in given by $\Omega = \phi + i\,\psi$, ϕ denoting the potential and $\psi =$ const. denoting the lines of force. The results are applied to the case of an elliptic cylinder in a uniform field. J. S. G. T.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

1362. Magneto-Resistance Effect in Single Crystals of Cadmium. C. J. Milner. *Cambridge Phil. Soc., Proc.* 33. *pp.* 145–153, *Jan.*, 1937.—A method of growing single-crystal resistance specimens free, to a large extent, from strains and impurities is described. The magneto-resistance effect in Cd single cystals is studied in some detail at the temperature of liquid nitrogen, using sufficiently high magnetic fields to observe the linear effect found by Kapitza. Although it proved impossible, in general, to determine the orientation of individual crystals, the experiments suggest that the " critical field " of the linear effect is dependent on the orientation of the crystal with respect to the current and magnetic field, and not on the perfection of the crystal lattice. AUTHOR.

See also Abstract 1373.

MAGNETISM AND ELECTROMAGNETISM.

1363. Temperature Dependence of Spontaneous Magnetisation. K. Honda and T. Nishina. *Tohoku Univ., Sci. Reports,* 25. *pp.* 480–488, *Nov.,* 1936. *In English. Report No.* 376 *of Research Inst. for Iron, Steel and Other Metals.* It is claimed that the expressions for the spontaneous magnetisation given by Weiss, Heisenberg and Hironi-Hikosaka are in reality not those of spontaneous magnetisation but of induced magnetisation and that the temperature dependence of spontaneous magnetisation has not yet been deduced theoretically. These claims are borne out by experimental work on single crystals of Fe. H. J. H. S.

1364. Magnetic Anisotropy of Iron and Effect of Temperature. E. F. Titow. *Phys. Zeits. d. Sowjetunion,* 10. 3. *pp.* 337–347, 1936. *In German.*—It is shown from the Akulov theory that the anisotropy of a crystal is independent of the temperature but that the absolute value of the anisotropy constant changes. This constant (for any given orientation) may be deduced from the formula $K_t = C.J_t^{10}$ where C is a constant and J_t is the saturation intensity at a temperature *t*. Measurements on single crystals and on polycrystalline Fe, over the range 0–450° C., are in close agreement with the above formula. The fact that K_t and J_t for both single crystals and anisotropic polycrystals ase governed by the same relation shows that the anisotropy of polycrystals is determined by an irregular distribution of the single crystal axes and not by inner potentials or other factors. H. J. H. S.

1365. Velocity of Propagation of Magnetisation. F. D. Miroschnitschenko. *Phys. Zeits. d. Sowjetunion,* 10. 4. *pp.* 540–562, 1936. *In German.*—An explanation of the Barkhausen discontinuities and of the nature of the critical field when the velocity of propagation is zero is given in terms of the Akulov theory. A method is described for accurately determining the velocity of propagation of magnetisation which is simpler and may be extended to the measurement of much great velocities than the method of Sixtus and Tonks. A series of measurements is carried out on a Ni-Fe alloy (85 % Fe). The velocity is found to depend on H_e and ΔJ, the numerical relations being in agreement with those deduced from the formulæ of Sixtus and Tonks. H. J. H. S.

1366. Paramagnetic Susceptibility of Colloidal Platinum. N. Takatori. *Tohoku Univ., Sci. Reports,* **25.** *pp.* 489–503, *Nov.,* 1936. *In English. Report No.* 377 *of Research Inst. for Iron, Steel and Other Metals.*—The paramagnetic susceptibility of small particles of Pt is measured in connection with the particle size. The result shows that the paramagnetic susceptibility decreases with the diminution of particle size, and that the susceptibility decreases from $1{\cdot}01 \times 10^{-6}$ to $0{\cdot}78 \times 10^{-6}$ during the change of particle size from 15×10^{-4} to $0{\cdot}20 \times 10^{-4}$ mm. AUTHOR.

1367. Particle Size and Magnetic Susceptibility. S. S. Bhatnagar, M. R. Verma and M. Anwar-ul-Haq. *Kolloid Zeits.* **78.** *pp.* 9–18, *Jan.,* 1937.—The magnetic susceptibilities of Pb, Cu, S, Se, Te, Bi and Sb have been measured for particles of dimensions of about $0{\cdot}4\mu$. In all the cases examined it was found that the susceptibilities were equal to that of the compact element, after impurities such as oxides, hydroxides, and carbonates had been removed. Therefore no changes of magnetic susceptibility had occurred by agglomeration of purified particles of Pb, Bi and Sb, and consequently particle size must not influence this property. Measurements were also made for the leaf and dark modifications of Pb, and gave the same result as for the compact metal. It has also been shown that the conclusions of Rao [see Abstract 2393 (1936)] with respect to Cu, Bi and Sb are not valid, since he presumably had ignored the influence of inclusions in Cu and the formation of oxides and hydroxides in Bi and Sb. Further his citation from the work of Prins that Sb may be amorphous in the colloidal state is not contained in the original text. The conclusion is drawn that an alteration of the microcrystalline structure is solely responsible for the change of magnetic properties, and that the purity of the materials investigated is the all-important factor. H. H. Ho.

1368. Paramagnetism of Copper-Nickel Alloys. G. Gustafsson. *Ann. d. Physik,* **28.** 2. *pp.* 121–131, *Jan.,* 1937.—The paramagnetism of Cu-Ni alloys is investigated at temperatures up to 450° C. and the results agree with all recorded data except those of Gans and Fonseca. The reported existence of an inflexion in the susceptibility-composition graph at low Ni concentrations is not borne out; the results, in fact, show a definite linear variation. W. R. A.

1369. Paramagnetism of Anhydrous Cobalt Chloride and its Solutions in Cadmium Chloride and Manganese Chloride. C. Fehrenbach. *J. de Physique et le Radium,* **8.** *pp.* 11–22, *Jan.,* 1937.—$CoCl_2$ exists in two paramagnetic forms which obey Weiss equations having different constants, and have different Curie points. There is a reversible transition at 400° Abs. The behaviour of powdered and sublimed $CoCl_2$ is discussed in relation to the Cabrera equation. Measurements of the moments have been made in solutions of $CdCl_2$ and $MnCl_2$, containing non-magnetic and paramagnetic ions respectively. The contribution of the Co ion in the latter solution is derived by postulating an additivity rule. In general the transition temperature and the corresponding increase in the moments remain constant but the moment and Curie points of the two forms vary with composition. W. R. A.

1370. Electromagnetic Fields and Oscillations. L. Bergmann. *Die Physik,* 4. 5. *pp.* 205–216, 1936.—A general résumé is given of recent work on the above subject under the following headings: (1) Magnetic field of an electric current. (2) Electromagnetic induction. (3) Electromagnetic field and Maxwell's theory. (4) Alternating currents and propagation along conductors. (5) Skin effect and eddy currents. A. W.

1371. Representation of Electromagnetic Fields by Biquaternions. W. H. Watson. *Roy. Soc. Canada, Trans.* 30. *Sect. III. pp.* 105–113, *May,* 1936.—Gives the application of biquaternion analysis to Born's theory of the electromagnetic field. [See following Abstract.] A. J. McC.

1372. System of Functional Dynamics and Optics. W. H. Watson. *Roy. Soc., Phil. Trans.* 236*A. pp.* 155–190, *Jan.* 21, 1937.—This is an extended and more detailed study of the system, due to Volterra, discussed by the writer in a previous paper [see Abstract 493 (1935)] as the mathematical basis of a transformation theory of electromagnetism. The following topics are dealt with: the functional distance between two closed lines in space: motion of a line regarded as the motion of a point depending on two independent variables; definition of velocity and acceleration by functional differentiation; minimal surface as analogue of the straight line: possible physical meaning of force as defined by Volterra's equations: system of two lines and analogue of the conservation of momentum: geometrical optics with 2-dimensional rays corresponding to the dynamical trajectories; definition of phase, wave velocity vector: connection between loci of equal phase and the rays in 3-dimensions: transformation theory: question of the complete specification of the wave functional—non-linear relations between linear functionals: attempt to construct dynamics with the possibility of such non-linear relations; functional time; relativity of functional coordinate systems; representation of general electromagnetic field in functional dynamics; Born's hypothesis of limiting field intensity and the functional analogue of light; non-linear superposition of fields; use of biquaternions. [see preceding Abstract.] AUTHOR.

1373. Effect of Stretching and Twisting on the Discontinuous Process of Magnetisation in Fe, Ni and Fe-Ni Alloys. J. Ôkubo and M. Takagi. *Tohoku Univ., Sci. Reports,* 25. *pp.* 426–479, *Nov.,* 1936. *In English. Report No.* 375 *of Research Inst. for Iron, Steel and Other Metals.*—The chief results observed may be summarised:—(1) The discontinuities are chiefly distributed in the steep portion of the hysteresis loop; (2) a linear relationship exists between $\Sigma H \delta I_d$ (I_d = intensity of magnetisation due to the discontinuous process in field H) and the areas of the hysteresis loop under applied tensions and twists and (3) the contribution to the magnetisation by the change in the discontinuities caused by stress is determined by the relation between the change in maximum intensity of magnetisation and the total sum of the discontinuities observed during a half cycle of the hysteresis loop; three types are observed (*a*) when the intensity of magnetisation and the total sum of the discontinuities increase on increase of the applied stress (permalloy, 50 % Ni-Fe, 2 % Ni-Fe and Armco Fe on stretching), (*b*) when the two quantities decrease on increase of stress (Ni on stretching), and (*c*) when increase in the applied stress causes a decrease in the maximum intensity and the total sum increases (this occurs on twisting all the specimens examined). In (*a*) and (*b*) the magnetostriction of the material has a positive and negative sign respectively. The results are discussed and a general explanation is offered. H. J. H. S.

***1374. Anomaly in Magnetostriction of Iron. G. A. Beauvais.** *Onde Élec.* 15. *pp.* 755–767, *Dec.*, 1936.—When nickel is passed through a hysteresis cycle, it increases in length as the field diminishes from its maximum value through zero, and attains its maximum length when the field intensity is H_c. Thereafter shortening takes place, and a similar effect is noted for the second half of the cycle. With mild steel, as the field is reduced from its maximum value to zero, the rod lengthens to a maximum, then shortens rapidly to a value corresponding to the remanent magnetisation and continues to shorten to a minimum for the field H_c. As the reversed field increases, the rod lengthens to a maximum and thereafter shortens with increase of the reversed field. In the return half of the cycle the bar length undergoes a similar change. An amplifying set is described by which the difference of phase between a current which enters and that which leaves the set may be varied in a continuous manner, and the set is used for the automatic maintenance of longitudinal vibrations of the bar. With a nickel bar, reversal of the connections for this purpose takes place at the two points corresponding to the fields $\pm H_c$. With a bar of mild steel, reversals require to be made at points corresponding to the magnetic states indicated by B, C, D, F, G and H on the hysteresis cycle (see Fig. in original). The change of phase required at C and G, when the steel bar is still strongly magnetised, is anomalous and an explanation is lacking.
G. E. A.

1375. Influence of Stress on the Magnetic Secondary Effect. H. Kindler. *Ann. d. Physik*, 28. 4. *pp.* 375–384, *Feb.*, 1937.—In a 50 % Ni-Fe alloy subjected to stress, a marked dependence of the secondary effect on the stress is observed (an increase in secondary loss is found under elastic conditions and a decrease under plastic conditions). An alteration in secondary effect is observed in a Heusler alloy which has been subjected to two different thermal treatments (with a consequent alteration in structure). These two examples are put forward to show that the magnetic secondary effect is dependent on the stress. H. J. H. S.

***1376. Automatic Recording of Magnetisation Curves. W. Steinhaus and E. Schoen.** *Phys. Zeits.* 38. *pp.* 1–5, *Jan.* 1, 1937.—A method is described for photographically recording magnetisation curves of all types of ferromagnetic materials, from those of high permeability to the hardest permanent magnet steels. The record in two dimensions is obtained by using the same galvanometer (this method is commonly used for determining arrest points and is known as the Saladin apparatus). Modifications of the circuit are necessary for samples of different dimensions and permeability and these are described for use over the whole range of practical utility. H. J. H. S.

***1377. Torque Magnetometer. H. J. Williams.** *Rev. Sci. Instruments*, 8. *pp.* 56–60, *Feb.*, 1937.—The history of torque measurement as an index of ferromagnetic anisotropy is outlined. A simple magnetometer for torque measurement is described in detail and uses for the intrument are discussed. These include the measurement of anisotropy constants, coercive force, complete magnetisation curves for single directions, and rotational hysteresis losses. With auxiliary ballistic measurement residual inductions and demagnetising factors are obtainable.
Author.

[*See also* Abstracts 979, 1080, 1264, 1332, 1385.

MEDICAL RADIOLOGY AND ELECTROLOGY.

1378. Density of Radiographic Films. (Miss) K. C. Clark. *Radiography*, 3. *pp.* 3–9, *Jan.*, 1937.—In order to determine the optimum conditions of kilovoltage and exposure time in mA-sec., for clinical radiographs an Al step wedge, increasing in 2·6-mm. stages to 40 mm. thickness, each stage of which gives approximately 50 % increase in film density when exposed at 63 kV and 40 mA at 40-in. focal film distance, has been exposed under varying conditions. The effects of exposure time, open and closed fields, focal film distance, intensifying screens of differing efficiency and grids in producing a variation, in regional and intimate contrast, are discussed. Finally, even in the dark room, variations can occur due to the temperature or to the deterioration of the developer. T. A. C.

1379. Accuracy of X-Ray Dosage Measurements. H. Behnken. *Phys. Zeit.* 37. *pp.* 878–881, *Dec.* 15, 1936. *From the Reichsanstalt.*—The International Röntgen has been realised to an accuracy of at least 1 % as has been shown by the results of inter-comparison of the primary standards of the Bureau of Standards and the Reichsanstalt. Results reproducible to a few parts per 1000 can easily be obtained by adopting the Townsend compensation method of measurement and adopting a satisfactory experimental technique. The various sources of uncertainty are investigated and it is claimed that an accuracy of at least 1 part per 1000 should be attainable. Such an accuracy is, however, not required at present. G. E. B.

1380. Time Factor in Biological Reaction to Radiation. W. H. Love. *Brit. J. of Radiology*, 10. *pp.* 38–46, *Jan.*, 1937.—An analysis is based on the hypothesis that the effect of X- or γ-radiation on a whole colony or tissue depends on the dose received by the individual cells in the radiosensitive stage. It is assumed that the living cell, during its life cycle, passes through a stage during which it is particularly susceptible to the effects of radiation. According to the particular value chosen for the radiation, it is shown that quantitative reaction to a given dose in a particular tissue may (1) either increase with time factor, reach a maximum value and then decrease; or (2) remain independent of the time factor over a particular time range and then decrease; or (3) decrease continuously with the time factor. In the example chosen, the shape of the curve relating dosage and fractional biological effect is assumed to be sigmoid, but a similar analysis can be made for any type of survival curve. T. A. C.

1381. Radium Beam Therapy and H.V. X-Rays. A. S. Eve and L. G. Grimmett. *Nature*, 139. *pp.* 52–55, *Jan.* 9, 1937.—Over 120 gm. of Ra distributed in 30 units are at present in use, for the treatment of cancer by the beam method alone. The Ra is screened by a mass of Pb or W alloy, through a port in which the beam of γ-rays is directed at the required site. In unification with X-ray therapy the dosage is measured in *r* units. A figure is shown in which the intensity distribution of 11 monochromatic lines with energies ranging from a few kV up to $2 \cdot 2 \times 10^6$ V, of the Ra spectrum, is compared with the probable energy distribution of the continuous spectrum from a 10^6 V X-ray tube. In the absence of any experimental data, the latter is obtained from extrapolation of Kramers' law [see Abstract 863 (1924)], which has been found to hold for lower voltages of the order of 100 kV. The effects of filters of 1 mm. and 2 mm. of Pb are based on the absorption data of Read and Jones. The peak of X-radiation output is shown to occur at 600–700 kV, with little radiation at 10^6 V. In the γ-ray spectra there is an intense line at $1\cdot8\times10^6$ V. To generate radiation comparable in *quality* with the γ-rays of Ra a voltage approaching 3×10^6 would be required. There is, however, the compensating factor of *intensity*. The output in ergs from an X-ray tube can be equivalent to that from hundreds of gm. of Ra, permitting focus-skin distances of 1–2 m. and a higher " depth dose," while with the present small quantities of Ra at 5–10 cm. distance, there is a corresponding poor " depth dose," since both are governed by the inverse square law. Any advantage of Ra treatment would seem to depend on the property that a great part of the electromagnetic waves proceeding from Ra are shorter in wave-length than those that emerge from any X-ray tube at present in use. Although in the future the neutron and artificial radioactivity may find a place in radiation therapy, it is important at the moment, that there should be competent comparisons of the effect of Ra and X-ray treatment by therapists, pathologists, biologists and physicists. T. A. C.

1382. Delivery, Estimation and Control of Tissue Dosage in Radiation Therapy. C. A. P. Wood and T. A. Green. *Brit. J. of Radiology*, 10. *pp.* 73–93, *Feb.*, 1937.—A discussion on the delivery, estimation and control of tissue dosage in the radiation treatment of malignant disease is given. The subject is dealt with under the following heads—utilisation of radiation to the best advantage, selection of the region for treatment, choice of the ports of entry, equality of radiation, accurate aiming of radiation, accurate estimation of the dose delivered in the tissues and the control of dosage during treatment. The special methods devised at the Radium Beam Therapy Research, London, are described in detail, and graphs illustrating the method of research into the biological responses are shown. AUTHORS.

***1383. Directional Caliper: Its Clinical Uses in Radiation Therapy. T. A. Green.** *Brit. J. of Radiology*, 10. *pp.* 95–101, *Feb.*, 1937.—A description is given of an instrument by which radiation can be directed accurately and tissue dosage determined under the conditions of treatment. The clinical uses in radiation therapy are outlined. The instrument was developed and is in routine use at the Radium Beam Therapy Research, London, in connection with two 5-gm. teleradium units. AUTHOR.

***1384. Useful Accessory to the Directional Caliper. J. Read.** *Brit. J. of Radiology*, 10. *pp.* 102–104, *Feb.*, 1937.—An instrument is devised (a dosage rate indicator) which will locate a point on any isodose chart directly from the coordinates supplied by the directional caliper [see preceding Abstract] correcting for zero errors automatically.

OSCILLATIONS AND WAVES.

***1385. Characteristics of the Simple and Composite Magnetostriction Bar. K. Aoyagi.** *Radio Research, Japan, Report*, 6. *pp.* 51–67, *Oct.*, 1936.—Some characteristics of the simple and composite magnetostriction bar are described in this paper. The constants of an equivalent circuit of a 10-kc. magnetostriction bar are determined, and its properties as an electro-mechanical-electro-transformer are experimentally studied. A single frequency valve oscillator with magnetostriction coupler is made and its characteristics are investigated. These experiments have made it clear why the polarity of a grid coil of a magnetostriction oscillator of the Pierce type must be reversed. The vibration characteristics of a magnetostriction bar with another rod at one of its ends, *i.e.*, of a composite bar, are theoretically investigated. AUTHOR.

1386. Measurement of Electric Wave Propagation. A. Agricola. *A.T.M. No.* 67. *T4–T5, Jan.*, 1937.—A short account is given of the principles of the various measurements necessary to determine the characteristics of electric waves. The different sections deal with (I) Attenuation. (II) Measurement of field components and directional fields near the aerial and at a distance; and polarisation measurements. (III) Indirect methods for investigating the ionosphere—(1) long-period measurements, (2) fading and similar effects, (3) mutual modulation effect (Luxemburg effect) and (4) picture telegraphy. (IV) Measurements of ionospheric heights—(1) frequency variation method, (2) measurement of angle of incidence of the " sky " wave, and (3) impulse method. A. W.

1387. Polarisation of Radio Echoes. D. F. Martyn, J. H. Piddington and G. H. Munro. *Roy. Soc., Proc.* 158*A. pp* 536–551, *Feb.* 3, 1937.—The paper describes a relatively simple and flexible method of determining the polarisation ellipse of downcoming radio echoes. The method employs pulse emissions, and is therefore applicable when more than one echo is receivable, but avoids the difficulty of radio-frequency phase instability by a partial employment of the frequency change technique of Appleton and Ratcliffe, as modified by Martyn and Green. A simple method of determining the sense of rotation of the vectors in the polarisation ellipse, employing defocussing of the kathode-ray beam, is described. The results obtained afford strong evidence of magneto-ionic effects in the E-region of the ionosphere. These effects are found to be due to electrons and not to heavy ions. Further evidence is obtained of the occasional presence of a thin layer of electrons at the level of the E-region. It is found that the polarisations of echoes are elliptical, in accordance with Baker and Green's theory of limiting polarisation. AUTHORS.

1388. Ionisation in the Ionosphere during the Partial Solar Eclipse of June 19, 1936, at Shanghai. Mong-Kang Ts'en, En-Lung Chu and Pe-Hsien Liang. *Chinese J. of Physics*, 2. *pp.* 169–177, *Dec.*, 1936. *In English.*—This is a brief report of the measurements by the method of critical penetration frequency of the maximum intensities of ionisation in the ionospheric layers during the partial solar eclipse of June 19, 1936, at Shanghai. The results support the u.v. light theory of ionisation in the F_1-layer. For the E-layer these results suggest that a considerable part of the ionisation may be due to agents different from u.v. light. AUTHORS.

***1389. Automatic Radio Transmitter for Investigation of the Ionosphere. H. B. Wood.** *Inst. Eng. Australia, J.* 8. *pp.* 403–414, *Nov.*, 1936.—The paper described the design of a pulse-modulated radio transmitter, the frequency of which is automatically, and recurrently, varied from 1·6 to 10 Mc./s. at a constant rate of 28 kc./s. per second, together with a superheterodyne receiver which is automatically tuned to the transmitter. The output from the receiver is applied to a kathode-ray oscillograph, and the resulting ground pulse and echo pattern are recorded by an automatically-controlled camera. A new method of calibration of the records, involving the use of de-focussing of the oscillograph, is described. The apparatus continuously records variations of the effective height and ionisation density of the various reflecting layers. Apart from its purely scientific value, the information thus obtained will be of great value in predicting the operating wave-lengths in short-wave wireless communication at different times of the day and year. AUTHOR.

See also Abstracts 1172, 1309, 1322, 1333, 1357, 1370.

PHOTOELECTRICITY.

1390. Energy States of Valency Electrons of Zinc. M. Satô. *Tohoku Univ., Sci. Reports,* 25. *pp.* 771–784, *Dec.,* 1936. *In English. Report No.* 410 *of the Research Inst. for Iron, Steel and Other Metals.*—The photoelectric threshold, photoelectric selective emissions and selective absorptions of light of Zn are explained in terms of the energy levels of the valency electrons, and the nature of the so-called potential energy barrier in the surface layer of solid-Zn is thus clarified. Further, based on the results above obtained and referring to photoconductive effect it is concluded that the levels E_3 and E_4 are the conduction levels of the valency electrons and that, in the bulk mass of solid-Zn, the levels, E_1, E_2, E_3 and E_4, at least, are stationary ones. A discussion regarding the origin of the catalytic action in the surface layer of solid-Zn has also been made. [See also Abstract 5178 (1936).] AUTHOR.

1391. Photoelectric Emission. H. C. Rentschler and D. E. Henry. *Frank. Inst., J.* 223, *pp.* 135–145, *Feb.,* 1937.—The advantages of using the method previously described [see Abstract 1229 (1933)] for preparing clean surfaces for the study of photoelectric emission from different metals are briefly discussed. Experiments are described which show that when certain metal surfaces react with oxygen the shift in sensitivity toward the longer wave-length is due to a reaction and not to the physical nature of the surface and that the similar shift when an alkali metal deposits on another metal is likewise the result of a reaction. [See also Abstract 897 (1936).] AUTHORS.

***1392. New Type of Photo-Cell. G. A. Boutry.** *Comptes Rendus,* 204. *pp.* 120–122, *Jan.* 11, 1937.—Recent researches have shown that the photoelectric current from a photo-cell is only approximately proportional to the luminous flux received by the kathode. These departures from proportionality, which often vary with time for the same cell, put a serious limit to the accuracy of any instrument employing such a cell. A new cell is designed in which many undesirable features of other cells are eliminated or made sufficiently small to be negligible. Saturation is obtained with an accelerating potential of 3 or 4 volts. Cells of this type may find an application in television transmitters; the lower voltage used should reduce appreciably the background noise. The chief disadvantages of these cells in their present form is their delicate construction and large size. C. J. B. C.

1393. Shenstone Effect. A. H. Weber. *Frank. Inst., J.* 223. *pp.* 215–242, *Feb.,* 1937.—This paper is a report on the " Shenstone effect " (the variation of the photoelectric sensitivity of a metal as a function of electric currents passed through it) [see Abstract 1808 (1921)]. A systematic study of the effect of occluded gases on the total photoelectric emission of Mo was made as a continuation of previous work of a similar character on Bi. The experiments are divided into three groups corresponding to three stages of outgassing: (1) no outgassing; (2) partial outgassing; (3) good outgassing. Two photoelectric cells were used; one entirely free of waxed joints. The effect of temperature change on the " Shenstone effect " was also studied. It is concluded: (1) that the initial large increases in the photoelectric emission of Bi and Mo with the passage of currents through the metal (the original Shenstone effect) must be definitely attributed to the removal of occluded gasses from the metals: (2) that the observed variations in the photoelectric sensitivity of Mo as a function of the current through the metal are not due to some obscure effect of the current itself but are connected with a variation of the gas content of the metal superinduced by temperature change. The observed variations in the photoelectric sensitivity of the outgassed Mo are attributed to the formation and evaporation of an adsorbed electro-positive gas layer. This theory is shown to coordinate the large amount of data obtained. AUTHOR.

See also Abstracts 1009, 1010, 1077.

PIEZOELECTRICITY.

***1394. Quartz Piezoelectric Pressure Gauges. S. Fahrentholz, J. Kluge and H. E. Linckh.** *Phys. Zeits.* 38. *pp.* 73–78, *Feb.* 1, 1937.—Gauges in which the quartz plate is fixed to the casing, and the pressure is applied to one electrode, respond not only to thrust, but also to accelerating forces, and the records are thereby vitiated. In the new gauge the quartz plate is held by two fixed metallic membranes, which also serve as electrodes. The inner membrane is insulated, and the thrust is applied to the outer one. When the membranes are equally stiff, the resultant thrust on the quartz plate is half the applied thrust, whereas no stress is produced in the quartz by its own acceleration. P. V.

See also Abstract 1061.

THERMIONICS.

1395. Corpuscular and Thermal Fluctuations in Electron Tubes. W. Schottky. *Zeits. f. Physik,* 104. 3–4. *pp.* 248–274, 1937.—After considering the case of the space-charge-free initial discharge path and thermal fluctuations in a quiescent ideal electron gas, the author's recent fluctuation theory of discharges limited by space-charges is discussed from the thermal standpoint. It is shown that in a space-charge section the part of the discharge between the hot kathode and the space-charge boundary behaves like a partially thermal resistance whose fluctuations are, however, reduced by the effect of that part of the discharge between the space-charge boundary and anode. In amplifier valves the fluctuations of a space-charge section between kathode and control grid are magnified, not according to current but according to power. The final resulting fluctuation in the anode circuit, however, under normal conditions does not reach a value as great as the amplified effect in the anode circuit of thermal agitation in the external grid circuit. A discussion is also given of the general method of estimating fluctuation effects in conductors with corpuscular transport of electricity. A. W.

1396. Secondary Electron Emission of an Oxygen-Cæsium Electrode. P. W. Timofeew and A. I. Pjatnitzki. *Phys. Zeits. d. Sowjetunion,* 10. 4. *pp.* 518–530, 1936. *In German.*—The secondary emission of electrons by complex surfaces is determined for an oxycæsium kathode and is shown, unlike the photo-effect, to be due to the distribution of metal particles inside the oxide. Using different metal bases, the strongest emission of secondary electrons is obtained with a Ag base and a thickness of 200 molecules of Ag_2O. The difference in the value of the emission from pure metal and a complex surface of O_2-Cs type of kathode is due to the difference of free path of the electron in the metal and in the oxide. H. M. B.